

RENOVATIONS & ALTERNATIONS – PHASE 1

AT THE

C.B. LAMB ELEMENTARY SCHOOL

46 Schoolhouse Road
Wrightstown, NJ 08562

NORTH HANOVER TOWNSHIP
BOARD OF EDUCATION
331 Monmouth Road
Wrightstown, New Jersey 08562

CONSTRUCTION MANAGERS:
P.W. Moss & Associates

ARCHITECTS:
Netta Architects

APRIL 18, 2019

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**NORTH HANOVER TOWNSHIP BOARD OF EDUCATION
BURLINGTON COUNTY**

NOTICE TO BIDDERS

NOTICE IS HEREBY GIVEN, that sealed bids in duplicate are sought and requested by North Hanover Township Board of Education (hereinafter called "Owner"), for the Renovations & Alterations – Phase 1 at the C.B. Lamb Elementary School. Bids are requested for the Construction work in accordance with Drawings, Project Manual, and other Bidding and Contract Documents prepared by P.W. Moss & Associates, 7 Plumridge Drive, Doylestown, PA 18902.

Project: C.B. Lamb Elementary School
Renovations & Alterations – Phase 1 – Six (6) Classrooms
General Construction

Work Includes: All Work Associated with Renovations & Alterations – Phase 1 – Six (6) Classrooms

Contracts: Single Overall Construction – General Construction (GC)

Sealed bids will be received at the North Hanover Township Board of Education Offices, 331 Monmouth Road, Wrightstown, NJ 08562, on or before, Wednesday, May 22, 2019 at 11:00 AM Prevailing Time. Bids will be publicly opened and read aloud on the same day, time and location. No bids will be accepted after this time.

If a bid exceeds \$20,000.00, the bidder must be prequalified by the New Jersey Department of Treasury, Division of Property Management and Construction as required by law and have a valid and current Notice of Classification prior to the date that bids are received. Any bid submitted under the terms of the New Jersey statutes not including a copy of a valid and active prequalification/classification certificate may be rejected as non-responsive to the bid requirements pursuant to law.

Each bidder shall submit with its bid, a Certificate of Consent of Surety as per N.J.S.A. 18A:18A-25 from a Surety company stating that it will provide the bidder and all subcontractors, if successful, with a performance/payment bond in the full amount of the contract.

There will not be a scheduled prebid meeting for this project. Site visits are by appointment only and must take place Monday-Friday during non-school hours. All site visits must be pre-scheduled with P.W. Moss & Associates with Rick Takakjy via email only at ret@pwmoss.com. Non-scheduled site visits will not be permitted.

All requests for additional information and questions posed by Bidders must be submitted in writing and transmitted to P.W. Moss & Associates no later than May 8, 2019, via email only to Rick Takakjy at ret@pwmoss.com.

Free Electronic copies of the documents can be requested after April 19, 2019 and accessed by Bidders on the same date using a username and password protected website, made by written request only, via email to P.W. Moss & Associates at ret@pwmoss.com.

As bid security, each Bid shall be accompanied by a certified check or Bid Bond made payable to the Owner, in accordance with the amounts and terms described in the INSTRUCTIONS TO BIDDERS.

The Owner requires that all bids shall comply with the bidding requirements specified in the INSTRUCTIONS TO BIDDERS of the Contract Documents. The Owner may, at its discretion, waive informalities in bids, but is not obligated to do so, nor does it represent that it will do so. The Owner also reserves the right to reject any and all bids. Under no circumstances will the Owner waive any informality which, by such waiver, would give one Bidder substantial advantage or benefit not enjoyed by all Bidders. No Bidder may withdraw his bid before sixty (60) days after the actual date of the opening thereof, unless a mistake or error is claimed by the Bidder in accordance with the INSTRUCTIONS TO BIDDERS.

Bidding shall be in conformance with the applicable requirements of N.J.S.A. 18A:18A-1 et seq. pertaining to the "Public School Contract Laws".

The Bidder's attention is directed to the fact that all applicable federal, state, and municipal laws, ordinances, rules and regulations of all authorities having jurisdiction over construction work in the locality of the project shall apply to the Contract throughout, and they will be deemed to be included in the contract the same as if set forth therein at length, including, but not limited to, those laws identified in the INSTRUCTIONS TO BIDDERS. Bidders are required to comply with the requirements of N.J.S.A. 10:5-31 et seq. and N.J.A.C. 17:27 et seq. regarding Affirmative Action.

Pursuant to "The Public Works Contractor Registration Act" (P.L. 1999,c238), bidders and their subcontractors are required to be registered with the New Jersey Department of Labor and to possess a current certificate by said Department indicating compliance with the Act. Bidders are notified of this requirement of their compliance.

Pursuant to the "Business Registration of Public Contractors" (P.L. 2004, c57), bidders and all of their subcontractors are required to provide "proof of registration", a copy of the organization's "Business Registration Certificate", issued by the Division of Revenue, prior to any Contract award. No other form may be substituted.

The Bidder's attention is directed to the fact that before submitting a bid, the bidder shall fully inform himself as to all applicable federal, state, and municipal laws, ordinances, rules and regulations, of all authorities having jurisdiction over construction work, insurance, bonds, regulations, wage rates, underwriters approval and shall include in his bid a sum to cover the cost of all items included in the specifications and pertinent documents.

The Owner reserves the right to reject any or all bids pursuant to law and not award a contract for any portion of the Project if the Owner has not obtained the requisite approval for the Project or any portion thereof from the appropriate state agency. Any agreement entered into by the Board for any portion of the Project is expressly conditioned upon the Owner obtaining the requisite approval for the Project or any portion thereof. The Owner reserves the right to terminate the agreement if the Owner has not obtained the requisite approval for the Project or any portion thereof from the appropriate state agency.

INSTRUCTIONS TO BIDDERS

ARTICLE 1 PROJECT AND BID INFORMATION

1. Project Title: C.B. Lamb Elementary School Partial – Renovations & Alterations – Phase 1 – Six (6) Classroom Renovations
2. District: North Hanover Township Board of Education
331 Monmouth Road
Wrightstown, NJ 08562
3. Bid Opening Dates and Times: Bids will be received until May 22, 2019 on or before 11:00 am, local time. Bids will be opened at the same date, time and location.
4. Bids will be received at the following location until Bid Opening Date and Time stated above:
 - a. North Hanover Township Board of Education
331 Monmouth Road
Wrightstown, NJ 08562

**Please note that there is not direct street access to the Board Offices from Monmouth Road. All vehicle traffic must enter the C.B Lamb Elementary School, 46 Schoolhouse Road, Wrightstown, NJ and travel east and then north along the access road to the Board Offices located at the most northern part of the Upper Elementary School.

5. Bidders are invited to submit Bids for any, or all, of the following Prime Contracts:
 - a. General Work – Single Overall Prime Contractor.
6. Access to the Site: Bidders will be permitted prior to the scheduled Bid Opening Date and Time from 8:00 AM until 4:00 PM during school occupied days. **Site visits must be prescheduled.**
7. Visits to the site must be made by appointment only with the Construction Manager, Mr. Rick Takakjy, P.W. Moss & Associates via telephone at 215-880-0035 or email at ret@pwmoss.com.
8. Electronic documents for download will be available on or about April 18, 2019. Free Electronic copies of the documents can be requested and accessed by Bidders on the same date using a username and password protected website, made by written request only via email at ret@pwmoss.com.

ARTICLE 2 DEFINITIONS

1. Addenda: Written or graphic instruments issued by the Engineer prior to execution of the Contract which modify or interpret the Bidding Documents by additions, deletions, clarifications, or corrections.
2. Bid: Complete and properly signed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.
 - a. Base Bid: Sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents.
 - b. Alternate Price: Amount stated in the Bid as price for an Alternate portion of work, which includes materials, equipment or service for a portion of the Work as described on the bidding documents. The District reserves the right to select any, all, or none of the listed Alternates.

- c. Unit Price: Amount stated in the Bid as price per unit of measurement for materials, equipment or service or a portion of the Work as described on the Bidding documents as described on the Bidding Documents.
 - d. Allowances: Amount indicated in the specifications and included with the Bid. The amount may be based upon unit prices as described above or a lump sum. The Allowances may be based on unit pricing, the amount of the Allowance shall be increased or decreased by change order if the allowance is exceeded or not used.
 - e. Bidder: Person or entity who submits a bid.
 - f. Bidding Documents: The Bidding Requirements and Proposed Contract Documents set forth in Article 4.
3. District: North Hanover Township Board of Education

ARTICLE 3
BIDDING PROCEDURES

- 1. Sealed bids, addressed to the District and identified by the contract being bid and by the words "North Hanover Township C.B. Lamb Elementary Renovations & Alterations – Phase 1", will be received by the District at the time and place listed and for the contracts listed in Article 1 - Project and Bid Information.
- 2. Bid Forms: Complete the Bid Form provided, in duplicate, with all blank spaces for Base Bid, Alternates, and Unit Price prices completed in ink, or typewritten, in both words and figures and the signature must be in ink. In the event of a discrepancy between the words and the figures written words shall govern. In submitting a bid, the Bidder warrants that the person signing the bid form has the authority to sign on behalf of the Bidder.
 - a. An additional copy of the Bid Forms modified to reflect any alterations made by Addendum, will be sent to all Bidders at least seven (7) days prior to the Bid Opening Date and Time specified above. If Addenda does not modify the Bid Forms, the Bidder is to use the Forms provide.
- 3. Bid Security: All bid guaranties must be issued by a surety licensed to issue such guaranties in the State and must be acceptable to the District. In order to guarantee the fulfillment of the provisions of these general stipulations and specifications:
 - a. Submit, with the Bid, bid security in the amount of 10 percent of the Bid, but not in excess of \$20,000 pursuant to NJSA 18A: 18A-24 and Grant Agreement 5.9, in any of the following forms:
 - (1) Bank cashier's check, payable to the District (drawn on a state or national bank rated "A")
 - (2) Certified check, payable to the District (drawn on a state or national bank rated "A")
 - (3) Bid Bond, payable to the District, on AIA Document A310 "Bid Bond" or standard bid bond form, duly executed by the Bidder as principal and with a surety company approved by the District. Submit, with each bond, a certified copy of the "power of attorney" for each attorney-in-fact who signs the bond.
 - b. Submit with the bid a certificate from a surety company stating that it will provide the Bidder with a bond in such sum as is required in the Instructions to Bidders pursuant to NJSA 18A:18A-25.
 - c. After the Bid Opening, bid security will be returned to all bidders, except for the three (3) apparent low responsible bidders, within 10 days, excluding Sundays and holidays. The three (3) apparent low responsible bidders bid security will be returned within 10 days of receipt from the successful bidder, the executed contract, excluding Sundays and holidays.

- d. Upon failure or refusal to submit a Performance Bond and Labor and Material Bond specified in the General Conditions and to execute District/Contractor Agreement within 10 days after notification of acceptance of his Bid, the accepted Bidder shall be deemed to have abandoned the Contract and his bid security will be forfeited to the District. In the event any bidder shall, upon award of the contract, fail to comply with the requirements herein after stated as to a bond guaranteeing the performance of the contract, the good faith deposit by cash, certified check or bond shall be released to the District and become and remain the property of the District..
4. Submission of Bids: Submit each Bid in a sealed envelope bearing the name and address of the Bidder and name and number of the Project on outside. Deliver all Bids to the location specified above no later than the Bid Opening Date and Time specified above. All Bids received after specified Bid Opening Date and Time shall not be opened.
5. Bid Attachments: The sealed bid shall included duplicates of the following attachments:
- a. Non Collusion Certificate (included as Bid Form Attachment #1)
 - b. Certified Corporate resolution indicating the Contractor's intention to submit a bid for the project (included as Bid Form Attachment #2)
 - c. Stockholder/Partnership Disclosure Statement (included as Bid Form Attachment #3)
 - d. Certificate pursuant to NJSA 18A:18A-32 (included as Bid Form Attachment #4)
 - e. Affirmative Action Affidavit (included as Bid Form Attachment #5)
 - f. Sworn contractor certification regarding qualifications and credentials pursuant to NJSA 18A:7G-37 (included as Bid Form Attachment #6)
 - 1) Attach the **Public Works contractor's registration certificate** pursuant to NJSA 34:11-56.48 *et seq* to the Bid Form Attachment #6
 - 2) Out of state contractors must attach the "**Certificate of Authority** to perform work in New Jersey" issued by the Department of the Treasury to the Bid Form Attachment #6
 - 3) Attach any valid trade licenses required under applicable New Jersey law to the Bid Form Attachment #6
 - 4) Attach the New Jersey **Business Registration Certificate** to the Bid Form Attachment #6
 - g. Sworn statement indicating contractor's debarment status (included as Bid Form Attachment #7)
 - h. Contractor's Qualification Questionnaire (included as Bid Form Attachment #8)
 - i. Equipment Certification (included as Bid Form Attachment #9)
 - j. NJ DPMC Prequalification Certificate
 - k. Uncompleted Contracts Certificates
 - l. Certificate from the Bidder's Surety indicating the Surety's intent to provide a Performance Bond, as indicated above (Article 3, #3, b. of this document)
 - m. Certificate of Compliance with New Jersey Prevailing Wage Act (included as Bid Form Attachment #10)
 - n. Certificate of Equal Opportunity (included as Bid Form Attachment #11)
 - o. Certificate of Insurance Certificate (included as Bid Form Attachment #12)

- p. Iran Disclosure of Investment Activities (included as Bid Form Attachment #13)

6. Withdrawal of Bid

- a. Any Bid may be withdrawn anytime prior to Bid Opening Date and Time specified above or authorized postponement.
- b. Bids may not be withdrawn before 60 days after Bid Opening Date and Time, unless a mistake or error is claimed by Bidder.
 - (1) If Bidder claims to have made a mistake or error in his Bid, he shall deliver to the Engineer within 24 hours after Bid Opening and Time, written notice describing in detail the nature of the mistake or error with documentary evidence or proof.
 - (2) Failure to deliver notice and evidence or proof specified above within the specified time period constitutes a waiver of the Bidder's right to claim error or mistake.
 - (3) Upon receipt of the specified notice and evidence or proof within the specified time period the Engineer and District shall conduct an appropriate hearing and determine if an excusable error or mistake has been made; and, if so, District may permit the Bid to be withdrawn. The determination of the District shall be conclusive upon the Bidder, his surety, and all who claim rights under the Bidder.

ARTICLE 4
BIDDING DOCUMENTS

- 1. Definition of Bidding Documents: Includes Bidding Requirements and Proposed Contract Documents.
 - a. Bidding Requirements - Consists of:
 - (1) Notice to Bidders
 - (2) Instructions to Bidders
 - (3) Bid Forms with attachments
 - b. Proposed Contract Documents - Consists of:
 - (1) Form of Agreement between the District and the Contractor
 - (2) Conditions of the Contract (General Conditions, Supplementary Conditions, and other conditions).
 - (3) Division 1 - General Requirements
 - (4) Drawings and Technical Specifications.
 - (5) All Addenda issued prior to execution of the Contract.
- 2. Bidding Documents are available:
 - a. Electronic documents for download will be available on or about April 18, 2019. Free Electronic copies of the documents can be requested and accessed by Bidders on the same date using a username and password protected website, made by written request only via email at ret@pwmoss.com.
- 3. Interpretation or Correction of Bidding Documents
 - a. Submit requests for interpretation of the meaning of the plans, specifications or other Bidding

Documents to the Construction Manager, in writing via email to Rick Takakjy at ret@pwmoss.com no later than May 8, 2019.

- b. Interpretations or corrections to Bidding Documents will be issued in the form of written Addenda to the Project Manual and Drawings as specified below. No interpretation or correction will be made to any Bidder orally.
4. Addenda: Written or graphic instruments issued by Engineer prior to execution of the Contract which modify or interpret the Bidding Documents by additions, deletions, clarifications, or corrections.
 - a. Addenda will be submitted to all Bidders by certified facsimile, meaning that the sender's facsimile machine produces a receipt showing date and time of transmission and that the transmission was successful. All Addenda will be sent no later than seven days, Saturdays, Sundays, and holidays excepted, prior to the specified Bid Opening Date and Time. All addenda, so issued, shall become part of the proposed Contract Documents.
 - b. Failure of any Bidder to receive any such addendum by reason of not having provided the Engineer with the proper Facsimile number and responsible person to whom such Addendum should be transmitted shall not relieve the Bidder from any obligation required by the Addendum.
 5. **Equivalents:** The use of manufacturer's brand names, catalog numbers, and similar proprietary identifying data in the Contract Documents is intended to establish a standard of quality, appearance, and function for those items. It is not the intention of the District to eliminate from consideration products that are equivalent in quality, appearance and function to those specified.
 - a. **Equivalents:**
 - 1) If a Bidder proposes to use products other than those listed in the Project Manual, the three (3) lowest Bidders are required to submit the Equivalent Listing form within 48 hours after the bid opening. The completed Equivalent Listing form, of proposed equivalent products, must include the following information:
 - (a) Applicable Project Manual section numbers and paragraph number.
 - (b) Proposed manufacturer's name, product brand name, and manufacturer's catalog/model number.
 - (c) Any aspect of the Contract Documents that cannot be complied with by the manufacturer or supplier of the proposed equivalent product.
 - 2) Failure to list and identify proposed equivalents shall be deemed to mean that the Bidder will furnish the materials or products indicated in the Contract Documents.

ARTICLE 5 BIDDER'S REPRESENTATIONS

1. By submitting a Bid at the specified Bid Opening Date and Time, each Bidder represents that he:
 - a. Has visited and thoroughly inspected the site and has fully informed himself of the conditions relating to the Project,
 - b. Has received, read, and is thoroughly familiar with the Contract Documents and any Addenda issued,
 - c. And has prepared his Bid based on the materials, equipment and systems specified on the Contract Documents or equivalents.
2. Failure to have taken the actions described in Paragraph 1 of this article will not relieve a successful

Bidder of his obligation to complete the Work of his Prime Contract as specified in the Contract Documents.

- 3. Insofar as possible, the Bidder agrees to employ such means and methods in carrying out Work of his Prime Contract as will not cause any interruptions of, or interference with, any other project being accomplished at the site, or the Districts normal operations.
- 4. Bidders are warned that the General and Supplementary Conditions and other provisions of the Contract Documents will be rigidly enforced.

ARTICLE 6
CONSIDERATION OF BIDS

- 1. Opening of Bids: At the Bid Opening Date and Time specified above, all bids received will be publicly opened and read aloud.
- 2. Rejection of Bids
 - a. The District requires that all Bids comply with the specified bidding requirements. However, the District may, in its discretion, waive informalities in Bids; but is not obligated to do so and does not represent that it will do so. Under no circumstances will the District waive any informalities which would give one a Bidder material or substantial advantage or benefit not enjoyed by all Bidders.
 - b. The District reserves the right, if in its judgment, the public interest will be promoted thereby, to reject any and all Bids not deemed in the best interests of the District, and to reject as non-responsive any bids as, in its opinion, are incomplete, conditional, obscure, or contain irregularities of any kind.
 - c. In rejecting a Bid, the District does not forfeit its right to accept the Bid of an individual Bidder for any other prime contract contained in this Project; and the rejection of a Bid is not necessarily a finding by the District of any facts or circumstances which would preclude that Bidder from bidding on future projects, or from being an acceptable subcontractor on any portion of this Project.
- 3. Acceptance of Bid (Award): This contract will be awarded to the responsible Bidders whose Bids shall comply with all conditions to render them responsive, who is able to furnish approved surety bonds, and whose Bid is the lowest number of dollars as defined below.
 - a. Lowest Bid may be:
 - (1) Base Bid as described in the contract documents, or
 - (2) Bid for the Base Bid plus any Alternates. or
 - (3) Bid for the Base Bid plus the total of all Lease Payments.
 - b. In the event there is a discrepancy between the Bid written in words and the Bid written in figures, the Bid in words shall govern. Bid Forms without the Bid written in words will not be accepted.
- 4. Notice to Proceed: The District shall issue a "Notice to Proceed" between May 29, 2019 and June 5, 2019. No Bidder may withdraw or amend his bid. Written acceptance shall constitute a contract between the District and the Bidder/s.

ARTICLE 7
POST-BID INFORMATION

1. Contractor's Qualifications
 - a. The District may make such investigations as He deems necessary to determine the ability of the Bidder to perform the Work.
 - b. The Bidder shall furnish to the District all such information and data for this purpose as the District may request.
 - c. The District reserves the right to reject any Bid if the evidence submitted by, or investigation of, such Bidder fails to satisfy the District that such Bidder is properly qualified to carry out the obligations of the Contract and to complete the Work contemplated therein.
2. District's Financial Capability: Successful Bidders shall submit requests to the District for information regarding the District's financial arrangements for this Project in accordance with Article 2, Paragraph 2.2.1 of General Conditions no later than 30 days after the specified Bid Opening Date and Time.
3. Submittals
 - a. The three apparent lowest responsible Bidders shall submit the following completed forms attached to the Bid Form no later than 48 hours after the specified Bid Opening Date and Time:
 - (1) Equivalent Listing: Refer to Article 4 above.
 - (2) Contractor's Subcontractors List
 - (3) Quick Assets and Liabilities Statement
 - (4) A statement of current claims made against the Bidders insurance aggregate
 - (5) Ahera notification acknowledgement
4. Time for making awards, deposit returned (NJSA 18A:18A-36)
 - a. The Contract shall be signed by all parties within the time limits set forth in the specifications, which shall not exceed 21 days, Sundays and holidays excepted, after the making of the award; provided, however, that all parties to the contract may agree to extend the limit set forth in the specifications beyond the 21 day limit required. The contractor, upon written request to the District, is entitled to receive, within seven days of the request, an authorization to proceed pursuant to the terms of the contract on the date set forth in the contract for work to commence, or, if no date is set forth in the contract, upon receipt of authorization. If for any reason the contract is not awarded and the Bidders have paid for or paid a deposit for plans and specifications to the District, the payment or deposit shall immediately be returned to the bidders when the plans and specifications are returned in reasonable condition within 14 days of notice that the contract has not been awarded.

ARTICLE 8
PERFORMANCE BOND, PAYMENT BOND, AND MAINTENANCE BOND

1. Bond Requirements
 - a. The successful Bidder shall furnish and maintain a Performance Bond and Labor and Material Bond in the amount of at least 100 percent of the Contract Amount; and a separate maintenance bond in an amount equal to ten percent (10%) of the accepted bid for guaranteeing repairs and correction of defective work and material in connection with the contract, for the period of two (2) years, with all premiums therefore paid by Bidder.
 - b. The surety for these bonds shall be a duly authorized surety company satisfactory to the District and licensed to do business in the State of New Jersey.

- c. Attorneys-in-fact who signs bonds must file with each bond a certified copy of their power of attorney to sign the bond.
2. Time of Delivery and Form of Bonds
- a. Deliver required bonds prior to the beginning construction activity at the site, but no later than 7 days after execution of the Contract.
 - 8. Use AIA Document A312, Performance Bond and Labor and Material Payment Bond, unless otherwise approved by District.

ARTICLE 9
MISCELLANEOUS PROVISIONS

1. All applicable laws, ordinances, rules, and regulations of federal, state, and municipal authorities having jurisdiction over this Project shall apply to the Contract throughout, and will be deemed to be included in the Contract as though herein written out in full. This Project shall be subject to and governed by applicable provisions of New Jersey State Law, including, but not limited to, the laws and regulations referenced in the Bidding and Contract Documents and the following:
- a. Public Schools Contract Law (PSCL) NJSA 18A:18A-1 *et seq*
 - b. Prequalification of bidders NJSA 18A: 18A-29.
 - c. Prevailing wage rates NJSA 34: 11-56.25 *et seq*; 34:1B-5.1 *et seq.*, 55:19-38.
 - d. Affirmative action NJSA 10:5-31 *et seq.*; P.L. 1975 c. 127.

END OF SECTION

**NORTH HANOVER TOWNSHIP BOARD OF EDUCATION
 C.B. LAMB ELEMENTARY SCHOOL PROJECT-RENOVATIONS & ALTERATIONS – PHAHSE 1
 SINGLE OVERALL CONTRACT BID FORM
 (Submit in Duplicate)**

BID FROM (Bidders name) _____
 (Address) _____

 (Phone & Fax) _____

CONTRACT: Single Overall Contract
 DOCUMENT DATE: April 18, 2019

I, (We), the undersigned certify meeting vendor qualifications and submit the following firm, fixed price in strict accordance with the terms and conditions of the Project Manual, dated April 18, 2019. I, (We), certify that I, (We), have examined and fully understand the requirements and intent of the Bidding and Contract Documents, including Drawings, Project Manual, and Addenda; and propose to furnish all labor, materials, and equipment necessary to complete the Work on, or before the dates specified in the Contract Documents for the Base Bid sums of:

BASE BID - All Work Associated with the C.B. Lamb Elementary School – Renovations & Alterations Phase 1 Project (Base Bid Price Includes \$ 30,000.00 General Allowance)

_____ (words)
 _____ (figures)

ATTACHMENTS

- 1. Attachment #1 - Non-Collusive Bidding Certificate: () Yes () No
- 2. Attachment #2 - Certified Corporate Resolution: () Yes () No
- 3. Attachment #3 - Stockholder/Partnership Disclosure Statement: () Yes () No
- 4. Attachment #4 - Certificate Pursuant To N.J.S.A. 18A: 18A-32: () Yes () No
- 5. Attachment #5 - Affirmative Action Questionnaire: () Yes () No
- 6. Attachment #6 - Certification Regarding Qualifications and Credentials: () Yes () No
 - Public Works Registration () Yes () No
 - Certificate of Authority () Yes () No
 - Valid trade licenses () Yes () No
 - Certificates of Registration from NJ Dept. of the Treasury, All Prime and Subcontractors () Yes () No
- 7. Attachment #7 - Certification Regarding Disbarment, Suspension, Disqualification: () Yes () No
- 8. Attachment #8 - Contractor's Qualification Questionnaire enclosed: () Yes () No
- 9. Attachment #9 - Equipment Certification: () Yes () No
- 10. Attachment #10 - Prevailing Wage Act & Davis- Bacon Certificate: () Yes () No
- 11. Attachment #11 - Equal Opportunity Certificate: () Yes () No
- 12. Attachment #12 - Certificate of Insurance Statement: () Yes () No
- 13. Attachment #13 – Disclosure of Iran Investment Activities: () Yes () No
- 14. NJ DPMC Notice of Classification and Uncompleted Contracts Form: () Yes () No
- 15. Bidder's Surety Certificate: () Yes () No
- 16. Affidavits/Statements – 00454,00455,00457,00458,00459 and Quick Assets/ Liability () Yes () No

LIST OF ADDENDA RECEIVED

No. _____ Date _____

No. _____ Date _____

No. _____ Date _____

No. _____ Date _____

BID BOND OR SURETY (10% OF THE SUM BID) - ENCLOSED IS: \$ _____

1. I am the _____ of _____
(Title) (Name of Bidder)

2. If Corporation: If Individual or Partnership:

Type name of Corporation

Type Name of Firm

President or Vice President Signature

Authorized Signature

Type Name and Title

Type Name and Title

Date

Date

Address

Address

Telephone

Telephone

Fax

Fax

()
()
()
(Corporate Seal)
()
()

Notarized by:

Subscribed and sworn to before me
this _____ day of _____, 20____
My commission expires _____, 20____

BID FORM ATTACHMENT #1

GENERAL CONDITIONS TO BID

NON-COLLUSION BIDDING CERTIFICATE

No Bid will be accepted that does not have this form completely executed.

By submission of this bid, each Bidder and each person signing on behalf of any Bidder certifies, and in the case of a joint bid each party thereto certifies as to its own organization, under penalty of perjury, that to the best of knowledge and belief:

- (a) The prices in this bid have been arrived at independently without collusion, consultation, communication, or agreement, for the purpose of restricting competition, as to any matter relating to such prices with any other Bidder or any competitor;
- (b) Unless otherwise required by law, the prices which have been quoted in this bid have not been knowingly disclosed by the Bidder and will not knowingly disclosed by the Bidder prior to opening, directly or indirectly, to any other Bidder or competitor;
- (c) No attempt has been made or will be made by the Bidder to induce any other person, partnership, or corporation to submit or not to submit a bid for the purpose of restricting competition;
- (d) The person signing this bid or proposal certifies that he has fully informed himself regarding the accuracy of the statements contained in this certification, and under the penalties of perjury, affirms the truth thereof, such penalties being applicable to the Bidder as well as to the person signing on his behalf;
- (e) That attached hereto (if corporate Bidder) is a certified copy of a resolution authorizing the execution of this certified signature of this bid or proposal on behalf of the corporate Bidder.

(Individual)

(Corporation)

Dated: _____ By _____

This Non-Collusion Bidding Certificate must be submitted with the bid.

BID FORM ATTACHMENT #2

CERTIFIED CORPORATE RESOLUTION

Resolved that _____ be authorized to sign and submit the bid or proposal of this corporation for the following project:

and to include in such bid the certificate as to non-collusion as to the act and deed of such corporation, as for any intentional inaccuracies or mis-statements in such certificate this corporate Bidder shall be liable under the penalties of perjury.

The forgoing is a true and correct copy of the resolution and adopted by _____ at the meeting of its board of directors held on the

_____ day of _____ 200__.

(Secretary)

This Corporate Resolution must be submitted with the bid.

BID FORM ATTACHMENT #3

STOCKHOLDER/PARTNERSHIP DISCLOSURE STATEMENT

Pursuant to and in accordance with NJSA 52:25-24.2, Bidders to supply public agencies; statement of ownership of 10% interest in corporation or partnership.

No Corporation or partnership shall be awarded any contract nor shall any agreement be entered into for the performance of any work or the furnishings of any materials or supplies, the cost of which is to be paid with or out of any public funds, by the State, or any county, municipality or school district, or any subsidiary or agency of the State, or of any county, municipality or school district, or by any authority, board, or commission which exercises governmental functions, unless prior to the receipt of the bid or accompanying the bid, of said corporation or said partnership there is submitted a statement setting forth the names and addresses of all stockholders in the corporation partnership who own 10% or more of its stock, of any class or of all individual partners in the partnership who own 10% or greater interest therein, as the case may be. If one or more such stockholder or partner is itself a corporation or partnership, the stockholders holding 10% or more of that corporation's stock, or the individual partners owning 10% or greater interest in that partnership, as the case may be, shall also be listed. The disclosure shall be continued until names and addresses of every noncorporate stockholder, and individual partner exceeding 10% ownership criteria established in this act, has been listed.

NAME & % OWNERSHIP

ADDRESS

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

(Continue listing additional names and addresses on separate sheet attached to this form.)

_____ No individual stockholder or partner owns 10% or more of this corporation or partnership.

(Authorized Signature)

(Title)

(Corporate Seal)

Representing: _____

Address _____

This Stockholder/Partnership Disclosure Statement must be submitted with the bid.

BID FORM ATTACHMENT #4

CERTIFICATE PURSUANT TO NJSA 18A:18A-32

The undersigned hereby certifies as follows:

1. I am the _____ of _____
(Title) (Name of Bidder)

2. I hereby certify that there has been no material change in the qualification information last submitted to the New Jersey Department of Treasury pursuant to NJSA 18A:18A-32, except as follows: (List changes or put "none".)

3. I certify that the forgoing statements are true and I am aware that if any such statements are willfully false, I may be subject to punishment.

Date _____

()	Name of Bidder
()	
()	_____
(Corporate Seal	(Corporate Name, if Bidder is Corporation)
()	Bidders Signature
()	
()	_____
()	(Corporate Officer, if Bidder is Corporation)

		(Title of Officer, if Bidder is a Corporation)

Notarized by:

Subscribed and sworn to before me
this _____ day of _____ 20 ____.
My commission expires 20 _____.

This Certificate Pursuant to NJSA 18A:18A-32 must be submitted with the bid.

BID FORM ATTACHMENT #5

AFFIRMATIVE ACTION QUESTIONNAIRE

Bidders are required to comply with the requirements of P.L. 1975, c. 127 (N.J.A.C. 17:27).

I hereby certify compliance with the requirements of the State of New Jersey, Department of Treasury, Affirmative Action Regulation P.L. 1975, c. 127 (N.J.A.C. 17:27).

I also acknowledge, if awarded the contract, within three (3) days after signing the contract, form AA201-A (Building Construction) and/or AA201-B (Heavy Construction) shall be completed and submitted to the Owner and the Affirmative Action Office.

Name of Firm _____

Signature _____

Title _____

Address of Firm _____

Date _____

This Affirmative Action Questionnaire must be submitted with the bid.

BID FORM ATTACHMENT #6

**SWORN CONTRACTOR CERTIFICATION REGARDING
QUALIFICATIONS AND CREDENTIALS**

Pursuant to NJSA 18A:7G-37 Submission of sworn contractor certification; requirements;

A Prequalified contractor seeking to bid school facilities projects, and any subcontractors required to be named under P.L.2000, c.72 (C.18A:7G-1 et-al.) shall, as a condition of bidding, submit a sworn contractor certification regarding qualifications and credentials.

- 1. We have a valid certificate of registration issued pursuant to "The Public Works Contractor Registration Act", P.L.1999, c.238 (C.34.11-56.48 et seq), a copy of which shall be attached to this certification form.
Yes_____ No_____
- 2. We have a current, valid "Certificate of Authority to perform work in New Jersey" issued by the Department of Treasury, a copy of which shall be attached to this certification form.
Yes_____ No_____
- 3. We have current, valid contractor trade licenses required under applicable New Jersey law for any trade or specialty area in which the firm seeks to perform work, a copy of which shall be attached to this certification form.
Yes_____ No_____
- 4. During the term of construction of the school facilities project, the contractor will have in place a suitable quality control and quality insurance program and an appropriate safety and health plan.
Yes_____ No_____
- 5. I, as a principal owner or officer of this company and at the time of bidding this project, certify that the amount of this bid and the value of all outstanding incomplete contracts do not exceed the firm's existing aggregate rating limit.
Yes_____ No_____
- 6. We, Along with **ALL** of our listed Subcontractors have a valid certificate of registration issued by the State of New Jersey Department of the Treasury pursuant to P.L.2004, c.57, all copies of which shall be attached to this certification form.
Yes_____ No_____

I certify that the forgoing statements are true and I am aware that if any such statements are willfully false, I may be subject to punishment.

Date_____

() Name of Bidder
 ()
 ()
 (Corporate Seal) _____
 () (Corporate Name, if Bidder is Corporation)
 () Bidders Signature
 ()
 () _____
 () (Corporate Officer, if Bidder is Corporation)

 (Title of Officer, if Bidder is a Corporation)

This Sworn Contractor Certification Regarding Qualifications and Credentials must be submitted with the bid.

BID FORM ATTACHMENT #7

**SWORN CONTRACTOR CERTIFICATION REGARDING
DEBARMENT, SUSPENSION, DISQUALIFICATION**

1. By signing and submitting this certification the Contractor is bound by the requirements set forth by this certification and by all applicable statues, laws, and rules that apply.
2. Indicate if, at the time of bidding this project, is the bidding Contractor or any of its principals, included on the State Treasurer's, or the Federal Government's List of Debarred, Suspended, or Disqualified Bidders as a result of action taken by any State or Federal agency.

Yes _____

No _____

Pursuant to applicable regulations;

1. The District shall award all Contracts for the school facilities Project accordance with the Public School Contracts Law, 18A:18A-18-1 *et seq.*, and the rules and regulations adopted pursuant thereto.
2. All Contractors engaged by the District and Subcontractors named in the branches specified in N.J.S.A. 18A:18A-18 who performs any work on the School Facilities Project shall be prequalified. The District shall not enter into a Contract with such Contractor or Subcontractor who has not been prequalified.
3. The District and its Consultants or Contractors shall not enter into a contract for work on the School Facilities project with any person or firm who has been debarred, suspended, or disqualified from State, or Federal government contracting.
4. The District shall insert in all Contracts with all Contracted Parties, and shall cause all contractors and Consultants to insert into all of their Contracts with all Subconsultants and Subcontractors, a clause stating that the contracted Party, its Subconsultants or Subcontractors may be debarred, suspended or disqualified from contracting and/or working on the school Facilities Project if found to have committed any of the acts listed in N.J.A.C. 17:19-3.1 *et seq.*, or any applicable regulation.
5. The District's bid specification for any work on the School Facilities Projects shall require all bidders to submit a sworn statement by the Bidder, or an officer or partner of the Bidder, indicating whether or not the Bidder is, at the time of the bid, included on the State Treasurer's, or the Federal government's List of Debarred, Suspended, or Disqualified Bidders as a result of action taken by any state or Federal agency. Bid specifications for the School Facilities Project shall also state that the District shall immediately notify the State, and the Unit of Fiscal Integrity in writing whenever it appears that a bidder is on the Treasurer's or the Federal government's List. The State reserves the right in such circumstances to immediately suspend such Bidder from contracting and to take such other action as is seemed appropriate pursuant to N.J.A.C. 17:19-3.1 *et seq.*, or any applicable regulation.
6. The District shall have a continuing and affirmative obligation so long as this Agreement is in effect to immediately notify the State, and the Unit of Fiscal Integrity in writing whenever it obtains knowledge that any Contracted Party, Subconsultant, or Subcontractor is on the Treasurer's, or the Federal government's List. The State reserves the right in such circumstances to immediately suspend such Contracted Party, Subconsultant, or Subcontractor from contracting and/or engaging in work on the School Facilities Project and to take such action as it deems appropriate pursuant to N.J.A.C. 17:19-3.1 *et seq.* or any applicable regulation.

SWORN CONTRACTOR CERTIFICATION REGARDING DEBARMENT, SUSPENSION, DISQUALIFICATION (CONT'D)

Please check one of the following:

I certify that the forgoing statements are understood and the information provided is true and I am aware that if any such statements are willfully false, I may be subject to punishment.

OR

I am not able to certify that the forgoing statements are understood and the information provided is true.

Date _____

() Name of Bidder
()
()
(Corporate Seal) (Corporate Name, if Bidder is Corporation)
() Bidders Signature
()
()
() (Corporate Officer, if Bidder is Corporation)
()
(Title of Officer, if Bidder is a Corporation)

Notarized by:

Subscribed and sworn to before me
this _____ day of _____ 20 ____
My commission expires 20 _____.

This Sworn Contractor Certification Regarding Debarment, Suspension, and Disqualification must be submitted with the bid.

BID FORM ATTACHMENT #8

CONTRACTOR'S QUALIFICATIONS QUESTIONNAIRE

Answer all questions, if not applicable write N/A.

1. Name of Bidder _____

2. Address _____

3. Phone # _____

4. Fax # _____

5. E- Mail _____

6. What is your organization's primary business? _____

7. How long have you been in business under the present name? _____

8. Provide complete information (name, address, and time in business) on former names for your organization. Attach additional sheets if more room is required.

9. List the categories of work your organization normally performs with its own workforce. Attach additional sheets if more room is required.

10. Attach a list of current projects currently under construction. Include with that list:

- Project and Owner's Name
- Project Address
- Architects Name and Phone #
- Construction Managers Name & Phone #
- Brief Project Description
- Contract Value
- Percentage of Completion
- Contract Completion Date

11. Attach a list of projects completed in the past five (5) years with similar requirements, size, and cost. Include with that list:

- Project and Owner's Name
- Project Address
- Architects Name and Phone #
- Construction Managers Name & Phone #
- Brief Project Description
- Contract Value
- General Comments about the Project
- Project Completion Date

12. Have there been any liens placed on your organization, or by your organization to another

contractor or Owner, in the past five (5) years? If so indicate when, by or to whom, current status, and explain why.. Attach additional sheets if more room is required.

Date _____

(
(
(
(Corporate Seal)
(
(
(
()

Name of Bidder

(Corporate Name, if Bidder is Corporation)

Bidders Signature

(Corporate Officer, if Bidder is Corporation)

(Title of Officer, if Bidder is a Corporation)

Notarized by:

Subscribed and sworn to before me
this _____ day of _____ 20 ____.
My commission expires 20 _____.

This Contractor Qualification Questionnaire must be submitted with the bid.

BID FORM ATTACHMENT #9

EQUIPMENT CERTIFICATION

Pursuant with N.J.S.A. 18A:18A-23. Certificate of bidder showing ability to perform contract.

"There may be required from any Bidder submitting a bid on public work to any board of education, duly advertised for in accordance with law, a certificate showing that he owns, leases, or controls all necessary equipment required by the plans, specifications and advertisements under which bids are asked for and if Bidder is not the actual owner of leasee of any such equipment, his certificate shall state the source from which the equipment will be obtained, and shall be accompanied by a certificate from the owner or person in control of the equipment definitely granting to the Bidder the control of the equipment required during such time as may be necessary for the completion of that portion of the contract for which it is necessary."

CHECK ONE

() I _____ of
(Name)

(Contractor's Name)

certifies that we own, lease, or control all necessary equipment required by the plans, specifications and advertisements under which bids are asked for.

OR

() I _____ of
(Name)

(Contractor's Name)

certify that we are not the actual owners, lessee, or have control of all necessary equipment required by the plans, specifications and advertisements under which bids are asked for. We will be obtaining such equipment from (List names of the sources of the equipment required. If additional space is required attach a separate sheet.) Provide certificates from each owner or person in control of the equipment definitely granting you control of the required equipment.

This Contractor Equipment Certification must be submitted with the bid.

BID FORM ATTACHMENT #10

COMPLIANCE WITH NEW JERSEY PREVAILING WAGE ACT

Bidder's Past Record under the New Jersey Prevailing Wage Act (N.J.S.A. 34:11-56.25), inclusive and all acts amendatory thereof and supplemental hereto.

Special Instructions: Answer each question with a "yes" or "no" entered in the space provided and furnish additional information when required.

1. Has the bidder been notified by the Commissioner of Labor by notice issued pursuant to N.J.S.A. 34:11-56.37 that he has been blacklisted for failure to pay prevailing wages as required by the New Jersey Prevailing Wages Act or Davis-Bacon Act? _____
2. Has any person having an "interest" in the bidder within the meaning of N.J.S.A. 34:11-56.38 been blacklisted as aforesaid? _____
3. Has any person having an interest in the bidder within the meaning of N.J.S.A. 34:11-56.38 had any "interest" as aforesaid in any firm, corporation, or partnership which has been blacklisted as aforesaid?
4. If the answer to any of the aforesaid questions is "Yes" annex a full statement showing the date of action taken by the Commissioner of Labor, the subsequent action, if any, taken with respect to such action of the Commissioner, the name of the person, firm, corporation or partnership blacklisted by the Commissioner, and the nature, character and extent of the interest existing between the bidder and the name which was blacklisted as aforesaid.
5. Have you made application for certification pursuant to "The Public Works Contractor Registration Act" (PL 1999 C238)? Attach copy of current certificate, or, if pending, a copy of the completed application and proof of payment of the application fee.

BIDDER (Signature)

Print Name of Bidder

BID FORM ATTACHMENT #11
CERTIFICATE OF EQUAL OPPORTUNITY

Name of Bidder

Project No.

INSTRUCTIONS

This certification is required pursuant to 41 C.F.R. §60-2. Each Bidder is required to state in his Bid whether he has participated in any previous contract or subcontract subject to the equal opportunity clause; and, if so, whether he has filed all compliance reports due under applicable filing requirements.

CONTRACTOR'S CERTIFICATE

Contractor's Name: _____

Address: _____

1. Bidder has participated in previous contract or subcontract subject to the equal opportunity clause. Yes _____ No _____
2. Compliance reports were required to be filed in connection with such contract or subcontract. Yes _____ No _____
If yes, state what reports were filed and with what agency.
3. Bidder has filed all compliance reports due under applicable instructions.
Yes _____ No _____
4. If the answer to Item 3 is "no", please explain in detail on reverse side of this certification..

Certification: The information above is true and complete to the best of my knowledge and belief. A willingly false statement is punishable by law.

(Name and Title of Signer - Please Type)

(Signature)

Date: _____

BID FORM ATTACHMENT #12

NORTH HANOVER TOWNSHIP BOARD OF EDUCATION

CERTIFICATE OF INSURANCE STATEMENT

The Bidder fully understands the North Hanover Township Board of Education insurance requirements as stated in the Supplementary Conditions and agrees to provide all insurance required by these documents prior to award of contract.

BIDDER (Signature)

BIDDER - Print Name

NOTE:

Failure to sign this document may result in the rejection of your proposal

**BID FORM ATTACHMENT #13
NORTH HANOVER BOARD OF EDUCATION
IRAN DISCLOSURE OF INVESTMENT ACTIVITIES**

Proposer: _____

Pursuant to Public Law 2012, c. 25, and N.J.S.A. 18A:18A-49.4, any person or entity that submits a bid or proposal or otherwise proposes to enter into or renew a contract must complete the certification below to attest, under penalty of perjury, that the person or entity, or one of the person or entity's parents, subsidiaries, or affiliates, is not identified on a list created and maintained by the New Jersey Department of the Treasury as a person or entity engaging in investment activities in Iran. If the Director finds a person or entity to be in violation of the principles which are the subject of this law, s/he shall take action as may be appropriate and provided by law, rule or contract, including but not limited to, imposing sanctions, seeking compliance, recovering damages, declaring the party in default and seeking debarment or suspension of the person or entity.

I certify, pursuant to Public Law 2012, c. 25, and N.J.S.A. 18A:18A-49.4, that the person or entity listed above for which I am authorized to submit a proposal:

- is not providing goods or services of \$20,000,000 or more in the energy sector of Iran, including a person or entity that provides oil or liquefied natural gas tankers, or products used to construct or maintain pipelines used to transport oil or liquefied natural gas, for the energy sector of Iran,
AND
- is not a financial institution that extends \$20,000,000 or more in credit to another person or entity, for 45 days or more, if that person or entity will use the credit to provide goods or services in the energy sector in Iran.

In the event that a person or entity is unable to make the above certification because it or one of its parents, subsidiaries, or affiliates has engaged in the above-referenced activities, a detailed, accurate and precise description of the activities must be provided in part 2 below to the Owner under penalty of perjury. Failure to provide such will result in the proposal being rendered as non-responsive and appropriate penalties, fines and/or sanctions will be assessed as provided by law.

PART 2: PLEASE PROVIDE FURTHER INFORMATION RELATED TO INVESTMENT ACTIVITIES IN IRAN

You must provide a detailed, accurate and precise description of the activities of the proposer, or one of its parents, subsidiaries or affiliates, engaging in the investment activities in Iran outlined above by completing the boxes below.

Name: _____	Relationship to Proposer: _____
Description of Activities: _____ _____	
Duration of Engagement: _____	Anticipated Cessation Date: _____
Proposer Contact Name: _____	Contact Phone Number: _____

Certification: I, being duly sworn upon my oath, hereby represent and state that the foregoing information and any attachments thereto to the best of my knowledge are true and complete. I attest that I am authorized to execute this certification on behalf of the above-referenced person or entity. I acknowledge that the Owner is relying on the information contained herein and thereby acknowledge that I am under a continuing obligation from the date of this certification through the completion of any contracts with the District to notify the District in writing of any changes to the answers of information contained herein. I acknowledge that I am aware that it is a criminal offense to make a false statement or misrepresentation in this certification, and if I do so, I recognize that I am subject to criminal prosecution under the law and that it will also constitute a material breach of my agreement(s) with the Owner and that the Owner at its option may declare any contract(s) resulting from this certification void and unenforceable.

Full Name (Print): _____ Signature: _____

Title: _____ Date: _____

CONTRACTOR SUBCONTRACTOR LIST
SINGLE OVERALL CONTRACT

SUBMITTED BY ALL BIDDERS AT TIME OF BID

Approval of proposed subcontractors shall be in accordance with Article 5.2 of General Conditions and Supplementary Conditions.

Instructions:

1. List below various subcontractors whose figures have been used in preparing the Bid, and to whom subcontracts are expected to be awarded, upon Construction Manager's approval, should contract be awarded to the Bidder.
2. List only one (1) subcontractor for each item, unless otherwise indicated. Changes on approved subcontractors will not be permitted.
3. If the Classification is listed below as "**Project Required DPMC Qualifications**", the Bidder must include a qualified firm, even if the Classification Contractor is the same Entity as the Bidder. **DO NOT LEAVE REQUIRED CLASSIFICATION LINE BLANK.**

General Work (If a subcontract, name subcontractor with **Project Required DPMC Qualifications, If Bidder, list Bidder's Name**)

Mechanical Work (If a subcontract, name subcontractor with **Project Required DPMC Qualifications, If Bidder, list Bidder's Name**)

Electric Work (If a subcontract, name subcontractor with **Project Required DPMC Qualifications, If Bidder, list Bidder's Name**)

Plumbing Work (If a subcontract, name subcontractor with **Project Required DPMC Qualifications, If Bidder, list Bidder's Name**)

Other _____ (if a subcontract, name subcontract)

Other _____ (if a subcontract, name subcontract)

Other _____ (if a subcontract, name subcontract)

Other _____ (if a subcontract, name subcontract)

**NORTH HANOVER TOWNSHIP BOARD OF EDUCATION
C.B. LAMB ELEMENTARY SCHOOL PROJECT**

EQUIVALENT LISTING

SUBMITTED BY 3 LOW BIDDERS WITHIN 48 HOURS AFTER BID OPENING

In accordance with Article 7 of the Instructions to Bidders, list proposed equivalents and corresponding specified products below.

<u>Specified Products</u>	<u>Equivalent Product</u>
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SECTION 00454 - AFFIDAVIT OF TOTAL AMOUNT OF UNCOMPLETED CONTRACTS

(This form is to be used with the NOTICE OF CLASSIFICATION when submitting bids to the Department of Education).

I certify that the amount of uncompleted work on contracts is:

_____ Dollars (\$))

I further certify that the amount of this bid proposal, including all outstanding incomplete contracts, does not exceed my prequalification dollar limit.

Respectfully Submitted:

Affix Corporate Seal

Name of Firm: _____

By:(signature) _____

Title: _____

Date: _____

Address: _____

Sworn to and subscribed before me this ____ day of _____,2011.

Notary Public

END OF SECTION 00454

SECTION 00455 – AFFIDAVIT OF NO CHANGE IN STATUS

The Undersigned states by this Affidavit that subsequent to the latest such statement submitted by him (The Bidder) there has been no material adverse change in his qualification information, except as set forth in said Affidavit (NJSA 18:18A-32). Indicate “No Change” or “Changes as Follows”:

Subscribed and sworn
before me this _____
day of _____, 2011 .

Notary Public

Very truly yours,

Firm Name

By _____
Signature (Proprietor / General Partner /
Or Duly Authorized Principal Officer)

Typed Name (Same as Signature)

(Business Address)

END OF SECTION 00455

SECTION 00457 - AHERA NOTIFICATION

To all Contractors / Workers:

Pursuant to AHERA (Asbestos Hazard Emergency Response Act) Regulations, you are hereby informed that the Owner has conducted an inspection of its buildings for asbestos containing building materials. A Management Plan has been developed and approved. The Plan identifies asbestos containing building materials, assesses their friability (the potential to be crumbled or reduced to powder by hand pressure), and recommends actions based upon the potential release of asbestos fibers.

You are hereby informed that you have the right to inspect our Management Plan prior to the commencement of your work in our District. You are also directed to inform someone if you are going to be working in an area that may cause you to disturb any existing asbestos containing building materials.

Your signature below acknowledges that you have been informed prior to the commencement of work that you have been made aware of your rights under the AHERA Regulations.

Name: _____

Signature: _____

Company: _____

Address: _____

Date: _____

END OF SECTION 00457

SECTION 00458 - WORKER AND COMMUNITY RIGHT TO KNOW ACT REQUIREMENTS

1. It is required that the Contractor and/or Subcontractors ensure that containers of substances belonging to the Contractor and/or Subcontractors that are stored at the Owner's facility are properly RTK labeled. Refer to N.J.A. C. 8:59-5.10.
2. Surveys of hazardous substances stored at the Owner's facility by the Contractor and/or Subcontractor are to be provided to the Owner of the facility. Refer to N.J.A.C. 8:59-2.2(h).
3. Material Safety Data Sheets (MSDS) from manufacturers, suppliers, Contractors and/or Subcontractors must be provided to the Owner for all products present at, purchased for, and brought on site at the Owner's facility, prior to the delivery of the subject material to the site. Refer to N.J.A.C. 8:59-2.2(1).
4. All Contractors are to keep on file all MSDS's in their field office at the location where the material is used.

END OF SECTION 00458

SECTION 00459 - C.271 POLITICAL CONTRIBUTION DISCLOSURE FORM

To all Contractors / Workers:

All Bidders must complete the attached C.271 Political Contribution Disclosure Form **as soon as possible** and transmit the form to the North Hanover Township Board of Education via facsimile @ (609) 738-2659. The completed form must be received by the District prior to ten (10) business days from the award of the Contract to the lowest responsible bidder. Failure of the lowest responsible bidder to transmit this form within this time frame will not result in an extension of time for the project.

Attach a copy of this page to the facsimile as identification.

Name: _____

Signature: _____

Company: _____

Address: _____

Date: _____

COMPLETE THE ATTACHED C.271 STANDARD DISCLOSURE FORM

C. 271 POLITICAL CONTRIBUTION DISCLOSURE FORM

Required Pursuant To N.J.S.A. 19:44A-20.26

This form or its permitted facsimile must be submitted to the local unit no later than 10 days prior to the award of the contract.

Part I – Vendor Information

Vendor Name:		
Address:		
City:	State:	Zip:

The undersigned being authorized to certify, hereby certifies that the submission provided herein represents compliance with the provisions of N.J.S.A. 19:44A-20.26 and as represented by the Instructions accompanying this form.

Signature

Printed Name

Title

Part II – Contribution Disclosure

Disclosure requirement: Pursuant to N.J.S.A. 19:44A-20.26 this disclosure must include all reportable political contributions (more than \$300 per election cycle) over the 12 months prior to submission to the committees of the government entities listed on the form provided by the local unit.

Check here if disclosure is provided in electronic form.

Contributor Name	Recipient Name	Date	Dollar Amount

Check here if the information is continued on subsequent page(s)

END OF SECTION 00459

**NORTH HANOVER TOWNSHIP BOARD OF EDUCATION
C.B. LAMB ELEMNTARY SCHOOL PROJECT**

PREVAILING WAGE RATES

The New Jersey Department of Labor Prevailing Wage Rate Determination is available for review at the Board of Education Offices at 331 Monmouth Road, Wrightstown, NJ 08652.

QUICK ASSETS AND LIABILITIES
(To be submitted by successful bidders)

Statement of Quick Assets and Current Liabilities at close of business on _____
Submitted by _____

(The Bidder)

() An Individual

() A Copartnership

() A Corporation

TO BE COMPLETED FOR A COPARTNERSHIP

Date of Organization _____
State whether partnership is general, limited,
or association _____

Name of Partners

Address

_____	_____
_____	_____
_____	_____
_____	_____

TO BE COMPLETED FOR A CORPORATION

Date Incorporated _____
State _____
Capital paid in cash _____
Present officers of the corporation: _____

Title

Name

Address

President _____

Vice President _____

Secretary _____

Treasurer _____

If the by-laws of the corporation provide for other offices, attach statement listing their titles, names, and addresses.

DRAFT AIA[®] Document A105[™] - 1993

Standard Form of Agreement Between Owner and Contractor for a Small Project

where the Basis of Payment is a STIPULATED SUM

This AGREEMENT is made:
(Date)

BETWEEN the Owner:

[Redacted]

and the Contractor

[Redacted]

for the following Project:

Standard

[Redacted]

The Architect is:

[Redacted]

The Owner and Contractor agree as follows.

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

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

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

ARTICLE 1 THE CONTRACT DOCUMENTS

The Contractor shall complete the Work described in the Contract Documents for the project. The Contract Documents consist of:

- .1 this Agreement signed by the Owner and Contractor;
- .2 AIA Document A205, General Conditions of the Contract for Construction of a Small Project, current edition;
- .3 the Drawings and Specifications prepared by the Architect, dated [redacted], and enumerated as follows:

Drawings:

Number	Title	Date
[redacted]	[redacted]	[redacted]

Specifications:

Section	Title	Pages
[redacted]	[redacted]	[redacted]

- .4 addenda prepared by the Architect as follows:

Number	Date	Pages
[redacted]	[redacted]	[redacted]

- .5 written change orders or orders for minor changes in the Work issued after execution of this Agreement; and
- .6 other documents, if any, identified as follows:

ARTICLE 2 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION DATE

The date of commencement shall be the date of this Agreement unless otherwise indicated below. The Contractor shall substantially complete the Work not later than [redacted] () days , subject to adjustment by Change Order. (Insert the date or number of calendar days after the date of commencement.)

ARTICLE 3 CONTRACT SUM

§ 3.1 Subject to additions and deductions by Change Order, the Contract Sum is:

(\$)

§ 3.2 For purposes of payment, the Contract Sum includes the following values related to portions of the Work:

Portion of Work	Value (\$ 0.00)
[redacted]	[redacted]

§ 3.3 The Contract Sum shall include all items and services necessary for the proper execution and completion of the Work.

ARTICLE 4 PAYMENT

§ 4.1 Based on Contractor's Applications for Payment certified by the Architect, the Owner shall pay the Contractor as follows:

(Here insert payment procedures and provisions for retainage, if any.)

§ 4.2 Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate of [redacted] ([redacted]) per annum , or in the absence thereof, at the legal rate prevailing at the place of the Project.

(Usury laws and requirements under the Federal Truth in Lending Act, similar state and local consumer credit laws and other regulations at the Owner's and Contractor's principal places of business, the location of the Project and elsewhere may affect the validity of this provision.)

ARTICLE 5 INSURANCE

§ 5.1 The Contractor shall provide Contractor's Liability and other Insurance as follows:
(Insert specific insurance required by the Owner.)

Type of insurance	Limit of liability (\$ 0.00)
[Redacted]	[Redacted]

§ 5.2 The Owner shall provide Owner's Liability and Owner's Property Insurance as follows:
(Insert specific insurance furnished by the Owner.)

Type of insurance	Limit of liability (\$ 0.00)
[Redacted]	[Redacted]

§ 5.3 The Contractor shall obtain an endorsement to its general liability insurance policy to cover the Contractor's obligations under Section 3.12 of AIA Document A205, General Conditions of the Contract for Construction of Small Projects.

§ 5.4 Certificates of insurance shall be provided by each party showing their respective coverages prior to commencement of the Work.

ARTICLE 6 OTHER TERMS AND CONDITIONS

(Insert any other terms or conditions below.)

[Redacted]

This Agreement entered into as of the day and year first written above.
(If required by law, insert cancellation period, disclosures or other warning statements above the signatures.)

[Redacted]

OWNER (Signature)

(Printed name and title)

CONTRACTOR (Signature)

(Printed name and title)
LICENSE NO.:
JURISDICTION:

DRAFT AIA[®] Document A205[™] - 1993

General Conditions of the Contract for Construction of a Small Project

for the following PROJECT:

(Name and location or address):

Standard

THE OWNER:

(Name and address):

THE ARCHITECT:

(Name and address):

ARTICLE 1 GENERAL PROVISIONS

§ 1.1 THE CONTRACT

The Contract represents the entire and integrated agreement between the parties and supersedes prior negotiations, representations or agreements, either written or oral. The Contract may be amended or modified only by a written modification.

§ 1.2 THE WORK

The term "Work" means the construction and services required by the Contract Documents, and includes all other labor, materials, equipment and services provided by the Contractor to fulfill the Contractor's obligations.

§ 1.3 INTENT

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.

§ 1.4

OWNERSHIP AND USE OF ARCHITECT'S DRAWINGS, SPECIFICATIONS AND OTHER DOCUMENTS

Documents prepared by the Architect are instruments of the Architect's service for use solely with respect to this project. The Architect shall retain all common law, statutory and other reserved rights, including the copyright. They are not to be used by the Contractor or any Subcontractor, Sub-subcontractor or material or equipment supplier for other projects or for additions to this project outside the scope of the Work without the specific written consent of the Owner and Architect.

ARTICLE 2 OWNER

§ 2.1 INFORMATION AND SERVICES REQUIRED OF THE OWNER

§ 2.1.1 If requested by the Contractor, the Owner shall furnish and pay for a survey and a legal description of the site.

§ 2.1.2 Except for permits and fees which are the responsibility of the Contractor under the Contract Documents, the Owner shall obtain and pay for other necessary approvals, easements, assessments and charges.

ADDITIONS AND DELETIONS:

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

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

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

§ 2.2 OWNER'S RIGHT TO STOP THE WORK

If the Contractor fails to correct Work which is not in accordance with the Contract Documents, the Owner may direct the Contractor in writing to stop the Work until the correction is made.

§ 2.3 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 seven day period after receipt of written notice from the Owner to correct such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies, correct such deficiencies. In such case, a Change Order shall be issued deducting the cost of correction from payments due the Contractor.

§ 2.4 OWNER'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS

§ 2.4.1 The Owner reserves the right to perform construction or operations related to the project with the Owner's own forces, and to award separate contracts in connection with other portions of the project.

§ 2.4.2 The Contractor shall coordinate and cooperate with separate contractors employed by the Owner.

§ 2.4.3 Costs caused by delays or by improperly timed activities or defective construction shall be borne by the party responsible therefor.

ARTICLE 3 CONTRACTOR

§ 3.1 EXECUTION OF THE CONTRACT

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

§ 3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

The Contractor shall carefully study and compare the Contract Documents with each other and with information furnished by the Owner. Before commencing activities, the Contractor shall: (1) take field measurements and verify field conditions; (2) carefully compare this and other information known to the Contractor with the Contract Documents; and (3) promptly report errors, inconsistencies or omissions discovered to the Architect.

§ 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.

§ 3.3.2 The Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner through the Architect the names of subcontractors or suppliers for each portion of the Work. The Architect will promptly reply to the Contractor in writing if the Owner or the Architect, after due investigation, has reasonable objection to the subcontractors or suppliers listed.

§ 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, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work.

§ 3.4.2 The Contractor shall deliver, handle, store and install materials in accordance with manufacturers' instructions.

§ 3.5 WARRANTY

The Contractor warrants to the Owner and Architect that: (1) materials and equipment furnished under the Contract will be new and of good quality unless otherwise required or permitted by the Contract Documents; (2) the Work will be free from defects not inherent in the quality required or permitted; and (3) the Work will conform to the requirements of the Contract Documents.

§ 3.6 TAXES

The Contractor shall pay sales, consumer, use and similar taxes that are legally required when the Contract is executed.

§ 3.7 PERMITS, FEES AND NOTICES

§ 3.7.1 The Contractor shall obtain and pay for the building permit and other permits and governmental fees, licenses and inspections necessary for proper execution and completion of the Work.

§ 3.7.2 The Contractor shall comply with and give notices required by agencies having jurisdiction over the Work. If the Contractor performs Work knowing it to be contrary to laws, statutes, ordinances, building codes, and rules and regulations without notice to the Architect and Owner, the Contractor shall assume full responsibility for such Work and shall bear the attributable costs. The Contractor shall promptly notify the Architect in writing of any known inconsistencies in the Contract Documents with such governmental laws, rules and regulations.

§ 3.8 SUBMITTALS

The Contractor shall promptly review, approve in writing and submit to the Architect Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents. Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents.

§ 3.9 USE OF SITE

The Contractor shall confine operations at the site to areas permitted by law, ordinances, permits, the Contract Documents and the Owner.

§ 3.10 CUTTING AND PATCHING

The Contractor shall be responsible for cutting, fitting or patching required to complete the Work or to make its parts fit together properly.

§ 3.11 CLEANING UP

The Contractor shall keep the premises and surrounding area free from accumulation of debris and trash related to the Work.

§ 3.12 INDEMNIFICATION

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) including loss of use resulting therefrom, but only to the extent caused in whole or in part by 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.

ARTICLE 4 ARCHITECT'S ADMINISTRATION OF THE CONTRACT

§ 4.1 The Architect will provide administration of the Contract as described in the Contract Documents. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2 The Architect will visit the site at intervals appropriate to the stage of construction to become generally familiar with the progress and quality of the Work.

§ 4.3 The Architect will not have control over or charge of and will not be responsible for construction means, methods, techniques, sequences or procedures, or for safety precautions and programs in connection with the Work, since these are solely the Contractor's responsibility. The Architect will not be responsible for the Contractor's failure to carry out the Work in accordance with the Contract Documents.

§ 4.4 Based on the Architect's observations and evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor.

§ 4.5 The Architect will have authority to reject Work that does not conform to the Contract Documents.

§ 4.6 The Architect will promptly review and approve or take appropriate action upon 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.

§ 4.7 The Architect will promptly interpret and decide matters concerning performance under and requirements of the Contract Documents on written request of either the Owner or Contractor.

§ 4.8 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 so rendered in good faith.

§ 4.9 The Architect's duties, responsibilities and limits of authority as described in the Contract Documents will not be changed without written consent of the Owner, Contractor and Architect. Consent shall not be unreasonably withheld.

ARTICLE 5 CHANGES IN THE WORK

§ 5.1 After execution of the Contract, changes in the Work may be accomplished by Change Order or by order for a minor change in the Work. The Owner, without invalidating the Contract, may 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.

§ 5.2 A Change Order shall be a written order to the Contractor signed by the Owner and Architect to change the Work, Contract Sum or Contract Time.

§ 5.3 The Architect will have authority to order minor changes in the Work not involving changes in the Contract Sum or the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes shall be written orders and shall be binding on the Owner and Contractor. The Contractor shall carry out such written orders promptly.

§ 5.4 If concealed or unknown physical conditions are encountered at the site that differ materially from those indicated in the Contract Documents or from those conditions ordinarily found to exist, the Contract Sum and Contract Time shall be subject to equitable adjustment.

ARTICLE 6 TIME

§ 6.1 Time limits stated in the Contract Documents are of the essence of the Contract.

§ 6.2 If the Contractor is delayed at any time in progress of the Work 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, the Contract Time shall be extended by Change Order for such reasonable time as the Architect may determine.

ARTICLE 7 PAYMENTS AND COMPLETION

§ 7.1 CONTRACT SUM

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

§ 7.2 APPLICATIONS FOR PAYMENT

§ 7.2.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment for operations completed in accordance with the values stated in the Agreement. Such application shall be supported by such data substantiating the Contractor's right to payment as the Owner or Architect may reasonably require and reflecting retainage if provided for elsewhere in the Contract Documents.

§ 7.2.2 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 other encumbrances adverse to the Owner's interests.

§ 7.3 CERTIFICATES FOR PAYMENT

The Architect will, within seven days after receipt of the Contractor's Application for Payment, either issue to the Owner a Certificate for Payment, with a copy to the Contractor, for such amount as the Architect determines is properly due, or notify the Contractor and Owner in writing of the Architect's reasons for withholding certification in whole or in part.

§ 7.4 PROGRESS PAYMENTS

§ 7.4.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner provided in the Contract Documents.

§ 7.4.2 The Contractor shall promptly pay each Subcontractor and material supplier, upon receipt of payment from the Owner, out of the amount paid to the Contractor on account of such entities' portion of the Work.

§ 7.4.3 Neither the Owner nor the Architect shall have responsibility for the payment of money to a Subcontractor or material supplier.

§ 7.4.4 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 requirements of the Contract Documents.

§ 7.5 SUBSTANTIAL COMPLETION

§ 7.5.1 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 the Owner can occupy or utilize the Work for its intended use.

§ 7.5.2 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion which shall establish the date of Substantial Completion, shall establish the responsibilities of the Owner and Contractor, and shall 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.

§ 7.6 FINAL COMPLETION AND FINAL PAYMENT

§ 7.6.1 Upon receipt of a final Application for Payment, the Architect will inspect the Work. When the Architect finds the Work acceptable and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment.

§ 7.6.2 Final payment shall not become due until the Contractor submits to the Architect releases and waivers of liens, and data establishing payment or satisfaction of obligations, such as receipts, claims, security interests or encumbrances arising out of the Contract.

§ 7.6.3 Acceptance of final payment by the Contractor, a Subcontractor or material 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 8 PROTECTION OF PERSONS AND PROPERTY

§ 8.1 SAFETY PRECAUTIONS AND PROGRAMS

The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs, including all those required by law in connection with performance of the Contract. The Contractor shall promptly remedy damage and loss to property caused in whole or in part by the Contractor, or by anyone for whose acts the Contractor may be liable.

ARTICLE 9 CORRECTION OF WORK

§ 9.1 The Contractor shall promptly correct Work rejected by the Architect as failing to conform to the requirements of the Contract Documents. The Contractor shall bear the cost of correcting such rejected Work.

§ 9.2 In addition to the Contractor's other obligations including warranties under the Contract, the Contractor shall, for a period of one year after Substantial Completion, correct work not conforming to the requirements of the Contract Documents.

§ 9.3 If the Contractor fails to correct nonconforming Work within a reasonable time, the Owner may correct it and the Contractor shall reimburse the Owner for the cost of correction.

ARTICLE 10 MISCELLANEOUS PROVISIONS

§ 10.1 ASSIGNMENT OF CONTRACT

Neither party to the Contract shall assign the Contract as a whole without written consent of the other.

§ 10.2 TESTS AND INSPECTIONS

§ 10.2.1 Tests, inspections and approvals of portions of the Work required by the Contract Documents or by laws, ordinances, rules, regulations or orders of public authorities having jurisdiction shall be made at an appropriate time.

§ 10.2.2 If the Architect requires additional testing, the Contractor shall perform these tests.

§ 10.2.3 The Owner shall pay for tests except for testing Work found to be defective for which the Contractor shall pay.

§ 10.3 GOVERNING LAW

The Contract shall be governed by the law of the place where the project is located.

ARTICLE 11 TERMINATION OF THE CONTRACT

§ 11.1 TERMINATION BY THE CONTRACTOR

If the Owner fails to make payment when due or substantially breaches any other obligation of this Contract, following seven days' written notice to the Owner, the Contractor may terminate the Contract and recover from the Owner payment for Work executed and for proven loss with respect to materials, equipment, tools, construction equipment and machinery, including reasonable overhead, profit and damages.

§ 11.2 TERMINATION BY THE OWNER

§ 11.2.1 The Owner may terminate the Contract if the Contractor:

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

§ 11.2.2 When any of the above reasons exist, the Owner, after consultation with the Architect, 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' written notice, terminate employment of the Contractor and may:

- .1 take possession of the site and of all materials thereon owned by the Contractor;
- .2 finish the Work by whatever reasonable method the Owner may deem expedient.

§ 11.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 11.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 11.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, such excess shall be paid to the Contractor. If such costs exceed the unpaid balance, the Contractor shall pay the difference to the Owner. This obligation for payment shall survive termination of the Contract.

SUPPLEMENTARY GENERAL CONDITIONS

INTRODUCTION: The Supplementary General Conditions and the Specifications bound herewith shall be subject to all the requirements of the General Conditions of the Contract for Construction, Construction Manager as Adviser Edition, Document A232-2009, as issued by the American Institute of Architects, Washington, DC, except that the Supplementary Conditions shall take precedence over and modify any pages or statements of the General Conditions of the Contract for Construction and shall be used in conjunction with them as part of the Contract Documents. Where any subparagraph, or clause is modified or deleted by these supplementary conditions, the unaltered provisions of that article, paragraph, subparagraph, or clause remain in effect.

The following supplements modify, change or delete from or add to the General Conditions of the Contract for Construction.

ARTICLE 1 GENERAL PROVISIONS

Add the following to Article 1:

1.2. EXECUTION, CORRELATION AND INTENT

1.2.4 During the bidding period, questions or discrepancies called to the Construction Manager's attention, in writing, by the Bidder, will be answered by the Construction Manager by means of an addendum issued to all Bidders prior to receiving bids. All Addenda shall become a part of the Contract Documents. If any item of work is shown on the Drawings and not specified, or mentioned in the Specifications and not shown on the Drawings, the matter shall be brought to the attention of the Construction Manager during the bidding period so an addendum can be issued correcting the omission. If such correction is not made, the work in question shall be considered to be required as if it has been specified and shown on the Drawings.

1.2.5 Titles to sections and paragraphs in these specifications are introduced for reference only and shall not be construed as a complete aggregation and segregation of the several units of material and labor. The Contractor shall be responsible for installation of all Work regardless of real or alleged error in arrangements of the Specifications.

1.2.6 The General Conditions, Supplementary Conditions, Specifications and Drawings contemplate a finished piece of work of such character and quality as is described in and is reasonably inferable from them. The Contractor, recognizing the impossibility of producing Drawings and Specifications with perfect accuracy, agrees that his submitted price for the Work hereunder includes sufficient money allowance to make his work complete. He agrees that inadvertent discrepancies or the failure to repeat on any Drawing the figures or notes given on another, shall not be the cause for additional charges or claims.

1.2.7 For any items which may, through oversight, be omitted from the schedule, Drawings, or Specifications or for which no symbol or other designation is given for identification, but in the absence of any definite instructions from the Architect or Construction Manager, such items shall be figured and finished to correspond with similar items for which information is given. The Drawings are intended to show the general arrangement, design, and extent of the work and are partly diagrammatic. They are not intended to be scaled for roughing-in measurements nor to serve as shop drawings.

ARTICLE 2 OWNER

Add the following to Article 2:

Modify Paragraph 2.3 as follows:

Delete the word "repeatedly" in the first sentence.

Add the following to Article 2:

2.4.1 Work that is not in accordance with the Contract Documents shall include conformance to the Drawings and Specifications, work not properly coordinated with other trades, and work not properly scheduled. The Architect shall decide whether work is in conformance to the Plans and Specifications. The Construction Manager shall make all decisions regarding coordination or schedule. In the event of a dispute between Architect and Contractor regarding conformance with the Drawings and Specifications, the Construction Manager shall be the sole judge and arbiter. All decisions by the Construction Manager shall be final.

2.4.2 If, in the opinion of the Construction Manager, work to be corrected by the Owner is judged to be crucial or time critical, the Construction Manager will inform the Owner, Contractor, and Architect of the crucial nature of the work. Upon notification, the ten day period noted in Article 2.4 will be reduced to five days.

ARTICLE 3
CONTRACTOR

Delete Paragraph 3.6 and replace with the following:

3.6 The Owner is exempt from payment of Federal, State, Local Taxes, and from payment of Sales and Compensating Use Taxes of the State of New Jersey and of Cities and Counties on all materials and supplies sold to the Owner pursuant to the provisions of this Contract. These taxes are not to be included in bids. This exemption does not, however, apply to tools, machinery, equipment, or other property leased by, or to the Contractor or a subcontractor; and the Contractor and his subcontractor shall be responsible for, and pay, any and all applicable taxes, including sales and compensating use taxes, on such leased tools, machinery, equipment or other property.

Delete Paragraph 3.7.1 and replace with the following:

3.7.1 The Contractor will secure and pay for all permits, governmental fees, licenses, inspections, and connection fees, excluding NJ DCA training fees, which will be paid by the Owner.

Add the following to Article 3:

3.18.1.1 For purposes of indemnification, the Owner shall be considered to be the North Hanover Township Board of Education.

3.18.3 To the fullest extent permitted by law, the Contractor shall indemnify, protect, defend, and save harmless the State of New Jersey, the Authority, and the Owner, as well as their respective agents, servants, officers, directors, and employees, from and against any loss, damage, injury, cost or expense; and from and against any Claim, demand, liability, lawsuit, judgment, action or other proceeding arising, to rise from, in connection with, or as a result of any of the following:

1.1 the acts or omissions of the Contractor, its agents, servants, officers, employees, subcontractors, subconsultants or any other person acting at the Contractor's request, subject to its direction, or on its behalf;

1.2 the loss of life or property, or injury or damage to the person, body or property of any person or persons whatsoever, that arises or results directly **or indirectly** from performance of the work or delivery of deliverables by the Contractor, its agents, servants, officers, employees, subcontractors, subconsultants, or any other person acting at the Contractor's request, subject to its direction, or on its behalf;

1.3 any negligence, default, breach, or errors or omissions of the Contractor, its agents, servants, officers, employees, subcontractors, subconsultants, or any other person acting at the Contractor's request, subject to its direction, or on its behalf;

1.4 violation or non-compliance, with Federal, State, local, municipal laws and regulations, ordinances, building codes (including without limitation the American Disabilities Act, OSHA, Environmental Protection Act) arising from the performance or non-performance of; or arising out of conditions created or caused to be created by, the Contractor, its agents, servants, officers, employees, subcontractors, subconsultants, or any other person acting at the Contractor's request, subject to its direction, or on its behalf; and

1.5 the use of copyrighted or uncopyrighted composition, secret process, patented or unpatented invention, article or appliance furnished or used in the performance of the work.

3.18.4 The Contractor's indemnification obligation is not limited by, but is in addition to the insurance obligations contained in the Contract Documents.

3.18.5 The Contractor agrees that any approval by the Owner of the work performed, and/or reports, plans, or Specifications provided by the Contractor shall not operate to limit the obligations of the Contractor under the Contract Documents; and that the Owner assumes no obligations to indemnify or save harmless the Contractor, its agents, servants, officers, employees, subcontractors, subconsultant against all claims that may arise out of its performance or nonperformance under the Contract Documents; and that the provisions of this indemnification clause shall in no way limit the Contractor's obligations under the Contract Documents, nor shall they be construed to relieve the Contractor from **any** liability, nor preclude the Owner from taking any other actions available to it under any other provisions of the Contract Documents or otherwise at law or equity.

3.18.6 The provision of this Section shall survive the termination of the Contract Documents.

ARTICLE 4
ADMINISTRATION OF THE CONTRACT

Delete paragraph 4.1.3 in its entirety.

Delete paragraph 4.2.4 and replace it with the following:

4.2.4 The Construction Manager will provide for coordination of the activities of the Owner's own forces with the work of the Contractor, who will cooperate with them.

Delete paragraph 4.2.13 and replace it with the following:

4.2.13 The Construction Manager and the Architect will take appropriate action on Change Orders or Construction Change Directives in accordance with Article 7. and the Architect and the Construction Manager will have authority to order minor changes in the Work as provided in Section 7.4. The Architect, in consultation with the Construction Manager, will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

Add the following to Article 4:

4.2.17.1 In the event of a dispute between Architect and Contractor concerning performance, compliance with the documents, or quality of work, the Construction Manager shall review the issue and render a decision. The Construction Manager shall be the sole judge and arbiter in such matters. All decisions by the Construction Manager shall be final.

ARTICLE 5
SUBCONTRACTORS

No modification to this contract is required.

ARTICLE 6
CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

No modification to this article is required.

ARTICLE 7
CHANGES IN THE WORK

7.2 Change Orders and Markup:

For all (extra or deleted) work by the Contractor’s own forces and/or work performed by any/all subcontractors, the markup of the gross of all work items (cost or credit) for each tier of subcontractor to the Owner shall include the net cost of the work of the contractor plus an allowance for overhead of 10% (maximum), plus then an allowance of for profit of 5% (maximum) and then an allowance for bond costs of 1.5% (maximum).

Add the following to paragraph 7.4:

The Construction Manager has authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes will be effected by written order issued through the Construction Manager and shall be binding on the Owner and Contractor.

ARTICLE 8
TIME

Add the following to Article 8:

8.2.4 The Contractor is required to commence work on with adequate forces to complete all contracted work no later than the dates established in Section 01310 Construction Schedule. The Contractor shall include all overtime and other premiums with the bid. The work site will be available twenty four (24) hours a day throughout the duration of the project, subject to local ordinances.

8.4 COMPLETION AND DAMAGES

8.4.1 The Contractor shall substantially complete all of his Work included in the Contract Documents as defined in the General Conditions as established in Section 01310 Construction Schedule, subject to extensions of contract time as provided in the General Conditions.

8.4.2 Pursuant to the provisions above, for each calendar day delay in said full and total completion of each milestone date, the Contractor shall pay to the Owner as liquidated damages, and not as a penalty, the sums as follows:

\$500.00 per day.

and the Contractor and his surety shall be liable for the amount thereof.

ARTICLE 9 PAYMENTS AND COMPLETION

9.3 APPLICATIONS FOR PAYMENT

Add the following:

9.3.1.3 Until Final Completion and acceptance of Work in accordance with Paragraph 9.10, the Owner shall pay 98 percent of the amount of each progress payment due the Contractor when the outstanding balance of the Contract exceeds \$500,000 if the Contractor has the bonds identified in Paragraph 11.4. When the outstanding balance of the Contract is \$500,000 or less, the Owner shall pay 95 percent of the amount of each progress payment due the Contractor.

9.3.1.4 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when (1) the Contract has been fully performed by the Contractor, including all punch list items, except for the Contractor's responsibility to correct nonconforming Work as provided in Subparagraph 12.2.2 of the General Conditions and to satisfy other requirements, if any, which necessarily survive final payment; (2) a final Project Certificate has been issued by the Construction Manager and Architect; and (3) after the Contractor's issuance of the final Project Certificate of Payment and all associated close-out documents required by the Contract Documents.

9.5 DECISIONS TO WITHHOLD CERTIFICATION

Modify Paragraph 9.5.1.7 as follows:

In line 1, delete the word "repeated".

9.8 SUBSTANTIAL COMPLETION

Add the Following to the end of Paragraph 9.8.1: "Substantial Completion shall be determined by the Construction Manager and Architect upon request from the Contractor."

9.8.1.1 When the Work, or designated portion thereof is determined to be substantially complete, the Architect will prepare a Certificate of Substantial Completion which shall establish the date of Substantial Completion, shall establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to Work and insurance, and shall 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 day of the Substantial Completion of the Work or designated portion thereof unless provided in the Certificate of Substantial Completion. The Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such certificate.

Delete Paragraph 9.8.2 in its entirety and replace with the following:

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 Construction Manager a comprehensive list of all items to be completed or corrected. 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. Together with this list, the Contractor shall provide a written request to the Construction Manager together with the Architect to perform an inspection of the Work. If this inspection discloses additional items beyond that submitted by the Contractor, a list of deficient or noncompliant items shall be provided to the Contractor within seven (7) days after the inspection. Failure for the Construction Manager or Architect 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.

The Contractor shall proceed promptly to correct the items. All items must be corrected by the Contractor within fourteen (14) days after receipt of the list from the Construction Manager or within an acceptable time frame established by the Contractor and Construction Manager and approved by the Construction Manager. Upon completion of those items the Contractor shall request, in writing, a re-inspection of the Work. This re-inspection shall commence within fourteen (14) days after receipt of notice. If upon the re-inspection, the Construction Manager or Architect finds that the previous items, or new items, do not conform the Construction Documents, a revised list shall be provided to the Contractor within seven (7) days. This sequence of actions shall take place until all items conform to the Contract Documents. The Contractor shall be liable to reimburse the Owner, by means of a Change Order, for all the costs and fees of the Construction Manager, Architect, Engineers and all professionals associated with re-inspections of Work beyond one (1) initial inspection and one (1) re-inspection of the Work.

9.8.2.1 If during the sequences of inspection and correction of Work, the Contractor defaults or neglects to carry out the correction of Work in accordance with the time frames established in 9.8.2 or in accordance with the approved schedule of correction, the Contractor shall be considered in default and the Owner shall exercise all rights under these Contract Documents. This shall also include Section 2.4 - Owner's Right To Carry Out The Work.

ARTICLE 10
PROTECTION OF PERSONS AND PROPERTY

Add the following to Article 10:

10.2.9 The Contractor is responsible for the safety and conduct of his employees and subcontractors. The Contractor shall conduct his work in accordance with all applicable laws and codes.

10.2.9.1 The Contractor shall endeavor to protect his employees, other workers, and the public from all unsafe or perceived unsafe conditions created by the Contractor.

10.2.9.2 The Contractor shall endeavor to protect his employees from all unsafe or perceived unsafe conditions created by persons other than the Contractor. Conditions believed to create a financial hardship shall be brought to the attention of the Construction Manager.

10.2.9.3 When leaving any area of the Work, temporarily or permanently, the Contractor shall leave the area in a safe condition for other workers and the public.

10.2.9.4 The facility will remain in operation and open to the public during the Work. The Contractor will take all necessary precautions to protect the patrons who use the facility during the Work.

10.2.9.5 The Contractor will not be relieved of responsibility for safety of his employees, the public, or property by agreements or conversations with employees or patrons of the facility.

10.2.8.6 The Contractor shall notify, in writing, the Construction Manager of all conditions and progress of the Work as they affect the safety and condition of the facility and the public.

ARTICLE 11
INSURANCE AND BONDS

11.1 CONTRACTOR'S LIABILITY INSURANCE

Add the following clauses:

11.1.1.9 The Contractor shall maintain in force and effect for life of the Project the following minimum types and levels of coverage. These coverages shall be maintained from one or more insurance companies licensed to do business in the State and rated as A or better as determined by A.M. Best Company or through formal, fully funded self- insurance programs authorized by law. All policies shall incorporate a provision requiring the giving of written notice to the Owner by certified mail, return receipt requested, at least thirty (30) days prior to the cancellation or re-newal of any such policies. **No payments shall be made under this Agreement until acceptable documentation of insurance coverage is received.** The Minimum required coverages are:

- i) Commercial General Liability Insurance. Basic coverage shall not be less than \$1 million per occurrence and excess/umbrella bringing total to \$1 million. Policy shall name the State, and the Department of Education as Additional insured.
- ii) Workers Compensation Insurance. Such coverage shall be as follows:

A.	Workers Compensation	Statutory
B.	Employer's Liability	\$500,000
- iii) Comprehensive Automobile Liability Insurance. Such policy shall include coverage for all owned, non-owned and hired vehicles, covering bodily injury and property damage in the amount of \$1 million combined single limit. Policy shall name the State, and the Department of Education as Additional insured.

Add the following clauses to Subparagraph 11.1.2:

11.1.2.1 All liability policies purchased by the Contractor must be purchased on an occurrence basis.

11.1.2.2 The following must be listed on the Contractor's certificate of insurance as additional insured:

- New Jersey State
- New Jersey Department of Education
- North Hanover Township Board of Education
- P.W. Moss & Associates
- Netta Architects
- Strunk-Albert Engineer
- Suburban Engineering

ARTICLE 12
UNCOVERING AND CORRECTION OF THE WORK

No modification to this article is required.

ARTICLE 13
MISCELLANEOUS PROVISIONS

13.1 GOVERNING LAW

Add the following paragraphs to 13.1:

13.1.2 The Contractor agrees to comply fully with the Affirmative Action requirements of P.L. 1975, C. 127, and all implementing regulations thereunder, all as amended and supplemented from time to time.

13.1.2.1 In Accordance with requirements of N.J.S.A. 10:5-31 et seq. and related regulations, the following provisions taken from the New Jersey Department of the Treasury are included in this Project.

13.1.2.2 Contractor's attention is directed to Paragraph below for submission requirements for Form AA-201. During the performance of this contract, the contractor agrees as follows: Affirmative Action Regulations P.L. 1975, c. 127:

EXHIBIT B (REVISED 4/10)

MANDATORY EQUAL EMPLOYMENT OPPORTUNITY LANGUAGE

N.J.S.A. 10:5-31 et seq. (P.L.1975, c.127)

N.J.A.C. 17:27-1.1 et seq.

CONSTRUCTION CONTRACTS

During the performance of this contract, the contractor agrees as follows:

The contractor or subcontractor, where applicable, will not discriminate against any employee or applicant for employment because of age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Except with respect to affectional or sexual orientation and gender identity or expression, the contractor will ensure that equal employment opportunity is afforded to such applicants in recruitment and employment, and that employees are treated during employment, without regard to their age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Such equal employment opportunity shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the Public Agency Compliance Officer setting forth provisions of this nondiscrimination clause.

The contractor or subcontractor, where applicable will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex.

The contractor or subcontractor will send to each labor union, with which it has a collective bargaining agreement, a notice, to be provided by the agency contracting officer, advising the labor union or workers' representative of the contractor's commitments under this act and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

The contractor or subcontractor, where applicable, agrees to comply with any regulations promulgated by the Treasurer, pursuant to N.J.S.A. 10:5-31 et seq., as amended and supplemented from time to time and the Americans with Disabilities Act.

When hiring or scheduling workers in each construction trade, the contractor or subcontractor agrees to make good faith efforts to employ minority and women workers in each construction trade consistent with the targeted employment goal prescribed by N.J.A.C. 17:27-7.2; provided, however, that the Dept. of LWD, Construction EEO Monitoring Program, may, in its discretion, exempt a contractor or subcontractor from compliance with the good faith procedures prescribed by the following provisions, A, B, and C, as long as the Dept. of LWD, Construction EEO Monitoring Program is satisfied that the contractor or subcontractor is employing workers provided by a union which provides evidence, in accordance with standards prescribed by the Dept. of LWD, Construction EEO Monitoring Program, that its percentage of active "card carrying" members who are minority and women workers is equal to or greater than the targeted employment goal established in accordance with N.J.A.C. 17:27-7.2. The contractor or subcontractor agrees that a good faith effort shall include compliance with the following procedures:

(A) If the contractor or subcontractor has a referral agreement or arrangement with a union for a

construction trade, the contractor or subcontractor shall, within three business days of the contract award, seek assurances from the union that it will cooperate with the contractor or subcontractor as it fulfills its affirmative action obligations under this contract and in accordance with the rules promulgated by the Treasurer pursuant to N.J.S.A. 10:5-31 et. seq., as supplemented and amended from time to time and the Americans with Disabilities Act. If the contractor or subcontractor is unable to obtain said assurances from the construction trade union at least five business days prior to the commencement of construction work, the contractor or subcontractor agrees to afford equal employment opportunities minority and women workers directly, consistent with this chapter. If the contractor's or subcontractor's prior experience with a construction trade union, regardless of whether the union has provided said assurances, indicates a significant possibility that the trade union will not refer sufficient minority and women workers consistent with affording equal employment opportunities as specified in this chapter, the contractor or subcontractor agrees to be prepared to provide such opportunities to minority and women workers directly, consistent with this chapter, by complying with the hiring or scheduling procedures prescribed under (B) below; and the contractor or subcontractor further agrees to take said action immediately if it determines that the union is not referring minority and women workers consistent with the equal employment opportunity goals set forth in this chapter.

(B) If good faith efforts to meet targeted employment goals have not or cannot be met for each construction trade by adhering to the procedures of (A) above, or if the contractor does not have a referral agreement or arrangement with a union for a construction trade, the contractor or subcontractor agrees to take the following actions:

(1) To notify the public agency compliance officer, the Dept. of LWD, Construction EEO Monitoring Program, and minority and women referral organizations listed by the Division pursuant to N.J.A.C. 17:27-5.3, of its workforce needs, and request referral of minority and women workers;

(2) To notify any minority and women workers who have been listed with it as awaiting available vacancies;

(3) Prior to commencement of work, to request that the local construction trade union refer minority and women workers to fill job openings, provided the contractor or subcontractor has a referral agreement or arrangement with a union for the construction trade;

(4) To leave standing requests for additional referral to minority and women workers with the local construction trade union, provided the contractor or subcontractor has a referral agreement or arrangement with a union for the construction trade, the State Training and Employment Service and other approved referral sources in the area;

(5) If it is necessary to lay off some of the workers in a given trade on the construction site, layoffs shall be conducted in compliance with the equal employment opportunity and nondiscrimination standards set forth in this regulation, as well as with applicable Federal and State court decisions;

(6) To adhere to the following procedure when minority and women workers apply or are referred to the contractor or subcontractor:

(i) The contractor or subcontractor shall interview the referred minority or women worker.

(ii) If said individuals have never previously received any document or certification signifying a level of qualification lower than that required in order to perform the work of the construction trade, the contractor or subcontractor shall in good faith determine the qualifications of such individuals. The contractor or subcontractor shall hire or schedule those individuals who satisfy appropriate qualification standards in conformity with the equal employment opportunity and non-discrimination principles set forth in this chapter. However, a contractor or subcontractor shall determine that the individual at least possesses the requisite skills, and experience recognized by a union, apprentice program or a referral

agency, provided the referral agency is acceptable to the Dept. of LWD, Construction EEO Monitoring Program. If necessary, the contractor or subcontractor shall hire or schedule minority and women workers who qualify as trainees pursuant to these rules. All of the requirements, however, are limited by the provisions of (C) below.

(iii) The name of any interested women or minority individual shall be maintained on a waiting list, and shall be considered for employment as described in (i) above, whenever vacancies occur. At the request of the Dept. of LWD, Construction EEO Monitoring Program, the contractor or subcontractor shall provide evidence of its good faith efforts to employ women and minorities from the list to fill vacancies.

(iv) If, for any reason, said contractor or subcontractor determines that a minority individual or a woman is not qualified or if the individual qualifies as an advanced trainee or apprentice, the contractor or subcontractor shall inform the individual in writing of the reasons for the determination, maintain a copy of the determination in its files, and send a copy to the public agency compliance officer and to the Dept. of LWD, Construction EEO Monitoring Program.

(7) To keep a complete and accurate record of all requests made for the referral of workers in any trade covered by the contract, on forms made available by the Dept. of LWD, Construction EEO Monitoring Program and submitted promptly to the Dept. of LWD, Construction EEO Monitoring Program upon request.

(C) The contractor or subcontractor agrees that nothing contained in (B) above shall preclude the contractor or subcontractor from complying with the union hiring hall or apprenticeship policies in any applicable collective bargaining agreement or union hiring hall arrangement, and, where required by custom or agreement, it shall send journeymen and trainees to the union for referral, or to the apprenticeship program for admission, pursuant to such agreement or arrangement. However, where the practices of a union or apprenticeship program will result in the exclusion of minorities and women or the failure to refer minorities and women consistent with the targeted county employment goal, the contractor or subcontractor shall consider for employment persons referred pursuant to (B) above without regard to such agreement or arrangement; provided further, however, that the contractor or subcontractor shall not be required to employ women and minority advanced trainees and trainees in numbers which result in the employment of advanced trainees and trainees as a percentage of the total workforce for the construction trade, which percentage significantly exceeds the apprentice to journey worker ratio specified in the applicable collective bargaining agreement, or in the absence of a collective bargaining agreement, exceeds the ratio established by practice in the area for said construction trade. Also, the contractor or subcontractor agrees that, in implementing the procedures of (B) above, it shall, where applicable, employ minority and women workers residing within the geographical jurisdiction of the union.

After notification of award, but prior to signing a construction contract, the contractor shall submit to the public agency compliance officer and the Dept. of LWD, Construction EEO Monitoring Program an initial project workforce report (Form AA-201) electronically provided to the public agency by the Dept. of LWD, Construction EEO Monitoring Program, through its website, for distribution to and completion by the contractor, in accordance with N.J.A.C. 17:27-7. The contractor also agrees to submit a copy of the Monthly Project Workforce Report once a month thereafter for the duration of this contract to the Dept. of LWD, Construction EEO Monitoring Program, and to the public agency compliance officer.

The contractor agrees to cooperate with the public agency in the payment of budgeted funds, as is necessary, for on-the-job and/or off the job programs for outreach and training of minorities and women.

(D) The contractor and its subcontractors shall furnish such reports or other documents to the Dept. of LWD, Construction EEO Monitoring Program as may be requested by the Dept. of LWD, Construction EEO Monitoring Program from time to time in order to carry out the purposes of these regulations, and public agencies shall furnish such information as may be requested by the Dept. of LWD, Construction EEO Monitoring Program for conducting a compliance investigation pursuant to N.J.A.C. 17:27-1.1 et seq.

13.1.3 PREVAILING WAGES

13.1.3.1 All Construction Contracts shall contain provisions that the Contractor and Subcontractor, as applicable, shall comply with the New Jersey Prevailing Wage Act, N.J.S.A. 34:11-56.25 et seq. The District shall not hire any Contractor or Subcontractor to perform any work for the District who is listed or is on record in the Office of the Commissioner, Department of Labor, as failing to pay prevailing wages in accordance with the provision of the New Jersey Prevailing Wage Act. [3.4]

13.1.3.2 All Construction Contracts shall contain provisions that the Contractor and Subcontractor, as applicable, shall comply with the Davis-Bacon Act (DBA). The DBA is intended to protect communities and workers from the economic disruption caused by competition arising from non-local contractors coming into an area and obtaining federal construction contracts by underbidding local wage levels. The DBA, as amended, requires each contract over \$2,000.00 to which the United States or the District of Columbia is a party for the construction, alteration, and/or repair (including painting or decorating) of public buildings or public works shall contain a clause setting forth the minimum wages to be paid to various classes of laborers and mechanics employed under the Contract. Under the provisions of the DBA, contractors and their contractors are required to pay laborers and mechanics employed directly upon the site of work no less than the locally prevailing wages and fringe benefits paid on projects of similar character.

13.1.4 PREQUALIFICATION LAW

13.1.4.1 Bidder on public work in the State of New Jersey must be qualified by the New Jersey State Department of Treasury. The Bidder must submit, with his bid, a notarized affidavit setting forth the type of work and the amount of work for which he has been qualified, that there has been no material change in his qualification information, and the total amount of incompleting work on contracts at the time and date of classification. [3.3.2]

13.1.4.2 All Contractors and Subcontractors who bid School Facilities Project shall be registered pursuant to N.J.S.A. 34:11-56.48 et seq. [3.9]

13.1.5 AMERICAN GOODS AND PRODUCTS TO BE USED WHERE POSSIBLE

13.1.5.1 Notwithstanding any inconsistent provision of any law, and unless the public officer charged with the duty of law shall determine it to be consistent with the public interest or the cost to be reasonable, only domestic materials shall be used for public work, as noted in N.J.S.A. 50:30-2 and Public School Contract Laws 18A:18A-20 et seq.

Delete Paragraph 13.6 in its entirety.

ARTICLE 14
TERMINATION OR SUSPENSION OF THE CONTRACT

Modify Paragraph 14.2.1.1 as follows:

Delete the word "repeatedly".

Modify Paragraph 14.2.1.3 as follows:

Delete the word "repeatedly".

ARTICLE 15
CLAIMS AND DISPUTES

Delete Article 15.4 in its entirety and all references to arbitration. Add the following:

All legal actions hereunder shall be conducted only in the New Jersey Superior Court, Law Division in Burlington County, New Jersey or the U.S. District Court in New Jersey, if applicable. The choice of jurisdiction and venue described in the preceding paragraph shall be mandatory and not permissive in nature, thereby precluding the possibility of litigation or trial in any jurisdiction or venue other than as specified herein. The parties waive any right to a jury trial and agree that all legal actions shall be tried as to factual and legal issues only to the court.

Unless otherwise agreed to in writing by the Construction Manager and the Owner, any dispute shall not be subject to arbitration or mediation. However, in case of any dispute, claim, question or disagreement arising from or relating to the project or arising out of the contract for Construction Manager's services or breach thereof, the parties shall first attempt resolution through mutual discussion.

SECTION 01010 - SUMMARY OF WORK

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 PROJECT IDENTIFICATION

A. The Project consists of Renovations & Alterations – Phase 1 at the C.B. Lamb Elementary School. All work must be of top quality with premium workmanship. The Project is located on 46 Schoolhouse Road, Wrightstown, NJ 08562.

1. The Work includes but is not limited to: All work associated with the Renovations & Alterations – Phase 1 Project including, but not limited to, General, Mechanical, Electrical and Plumbing Work.

2. Owner: North Hanover Township Board Of Education
331 Monmouth Road
Wrightstown, NJ 08562

3. Construction Manager: P.W. Moss & Associates
7 Plumridge Drive
Doylestown, PA 18902

C. Prime Contracts are separate contracts that represent significant construction activities performed concurrently with and closely coordinated with construction activities performed on the Project under other prime Contracts. Prime Contracts for this Project include:

1. Single Overall Contract.

D. Single Overall Contract Work: Each prime Contract can be summarized as follows:

1. The Single Overall Contract includes all of the construction work.

E. Definition of the extent of Contract Work: The extent of the Contract is indicated in the Contract Documents.

1.3 WORK UNDER OTHER CONTRACTS

A. A separate Contract may be issued to another Contractor to perform certain construction operations at the site. Those operations may or may not coincide with certain aspects of the Project and may or may not be scheduled to be substantially completed at the same time as construction operations under this Contract.

1. NHTBOE Summer Work and Building Occupancy.
2. C.B. Lamb Renovations & Alterations – Phase 2 (TBD)

1.4 WORK SEQUENCE

A. Required to properly install all work in accordance with the manufacturer's recommendations within scheduled milestone dates and during school hour operations. Proper coordination with

the Owner must take place.

1.5 SCHEDULE MILESTONE DATES

A. Each phase listed above must be completed by the specified dates. Failure to meet the milestone dates specified will be construed a contract default and subject to all remedies provide for in the General Conditions and Supplemental General Conditions, including but not limited to liquidated damages.

- 1. Commence Work (Notice to Proceed): May 29, 2019
- 2. Transmit All Project Submittals, Product Data and Samples by: June 30, 2019
- 3. Contract Renovations Work (Construction Schedule):
 - Start: June 20, 2019
 - Finish: (Temporary Certificate of Occupancy) August 30, 2019
- 4. Classroom Unit Ventilators & Adjacent Casework Installation & Finish
 - Start: June 20, 2020
 - Project Completion (Certificate of Occupancy): July 15, 2020

Please Note that the Contractor will be allowed to install the Classroom Units Ventilators and Associated Casework and Finish Items as Soon as Summer 2019, or During the 2019-2020 School Extended Breaks Pending Procurement and Delivery. Work Schedule during School Breaks must be Submitted and Approved by the Owner / Construction Manager. However, No Extension of Time or Additional Funds will be granted.

1.6 CONTRACTOR USE OF PREMISES

A. General: Limit use of the premises to construction activities to areas as indicated the four (4) phasing drawings located in this specification section.; the premises are to be in continuous use and operation during the Work, allow for full Owner occupancy and use by the public.

- 1. Confine operations to areas within Contract limits indicated. Portions of the site beyond areas in which construction operations are indicated are not to be disturbed.
- 2. Keep driveways and entrances serving the premises clear and available to the Owner, Owner's employees, and students 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. Schedule deliveries to minimize the impact upon the Owner's deliveries.
- 3. At all times the contractor is to maintain a clear separation of Work area and the Owner, Owner's employees, and students. A physical dust free barrier is to be erected to separate the Work area from the public areas.

B. Use of the Existing Premises: Repair damage caused by construction operations. Take all precautions necessary to protect the premises, its equipment, and its occupants during the construction period.

- 1. Schedule all activities so as to minimize disruption to the use of the Premises and as noted herein:
- 2. Provide advance notice of all construction activities to person or persons as designated by the Construction Manager.

C. Contractor Deliveries: Delays caused by lost deliveries or rejected items by the Construction Manager or Administration is the Contractor's responsibility.

- 1) **DO NOT DELIVER** materials unless the Contractor has means on site to unload, store, and handle all products being delivered.
- 2) **DO NOT DELIVER** materials via an overnight service such as UPS, DHL, Federal Express, US Mail, etc., or common carrier. All of these services must be sent to and offsite office or warehouse.
- 3) **DO NOT DELIVER** materials if the Contractor does not have a representative onsite to receive the delivery.
- 4) **NO DELIVERIES** will be received by the Construction Manager, Administration, or Architect. All deliveries that arrive to the project site without a contractor's representative available to receive the delivery will be refused and sent back to the sender. The Contractor is responsible for deliveries and responsible for any materials that may be lost as a result of misdirected goods. The Contractor is responsible to meet all schedules regardless of materials refused by the Construction Manager, Administration, or Architect.

E. Security

1. All persons on site are required to sign in to a log every day. The Contractor will furnish the sign in log, will remain on school premises at all times. The sign in log will contain pertinent information such as name, address and phone and other information as the Owner may deem necessary for security.
2. All persons on site will wear identification badges at all times. Badges will be furnished by the Owner. Lost badges will be replaced by the Owner at a cost of \$25.00 per badge per loss, to be paid by the Contractor.
3. No persons are permitted to work outside of designated areas without the Construction Manager's permission.
4. Any person failing to follow these security procedures will be removed from the site and not permitted to return.

PART 2 - PRODUCTS (Not applicable).

PART 3 - EXECUTION (Not applicable).

END OF SECTION 01010

SECTION 01020 - ALLOWANCES

PART I. - GENERAL

A. RELATED DOCUMENTS

1. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

B. SUMMARY

1. This Section specifies administrative and procedural requirements governing handling and processing allowances.

- a. Selected materials and equipment, and in some cases, their installation are shown and specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. Additional requirements, if necessary, will be issued by Change Order.

2. Types of allowances required include the following:

- a. Lump sum allowances.
- b. Unit-cost allowances.

3. Procedures for submitting and handling Change Orders are included in Section "Change Order Procedures."

C. SELECTION AND PURCHASE

1. At the earliest feasible date after Contract award, advise the Construction Manager of the date when the final selection and purchase of each product or system described by an allowance must be completed in order to avoid delay in performance of the Work.

- a. When requested by the Construction Manager, obtain proposals for each allowance for use in making final selections; include recommendations that are relevant to performance of the Work.
- b. Purchase products and systems as selected by the Architect from the designated supplier.

D. SUBMITTALS

1. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.
2. Submit invoices or delivery slips to indicate actual quantities of materials delivered to the site for use in fulfillment of each allowance.

PART II. - PRODUCTS (Not Applicable)

PART III. - EXECUTION

A. INSPECTION

1. Inspect products covered by an allowance promptly upon delivery for damage or defects.

B. PREPARATION

1. 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 construction activities.

C. SCHEDULE OF ALLOWANCES

1. Allowances - **Include as part of the Base Bid.**

- a. Item No. G1 - \$ 30,000.00 General Work Allowance. Additional Work to be as directed by the Construction Manager and / or Owner relative to the project's Scope of Work.

END OF SECTION 01020

SECTION 01027 - APPLICATIONS FOR PAYMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements governing the Contractor's Applications for Payment.
B. The Contractor's Construction Schedule and Submittal Schedule are included in Section "Submittals".

1.3 SCHEDULE OF VALUES

A. Coordinate preparation of the Schedule of Values with preparation of the Contractor's Construction Schedule.

1. Submit the Schedule of Values to the Engineer for approval at the earliest feasible date, but in no case later than 28 days before the date scheduled for submittal of the initial Application for Payment.
2. Sub-Schedules: Where the Work is separated into phases that require separately phased payments, provide sub-schedules showing values correlated with each phase of payment.

B. Identification: Include the following Project identification on the Schedule of Values:

1. Project name and location.
2. Name of the Engineer
3. Project number.
4. Contractor's name and address.
5. Date of submittal.

C. The Schedule of Values must include the following information.

1. Arrange the Schedule of Values in a tabular form with separate columns to indicate the following for each item listed:

- a. Generic name.
- b. Related Specification Section.
- c. Name of subcontractor.
- d. Name of manufacturer or fabricator.
- e. Name of supplier.
- f. Change Orders (numbers) that have affected value.
- g. Dollar value.
- h. Percentage of Contract Sum to the nearest one-hundredth percent, adjusted to total 100 percent.

2. Provide a breakdown of the Contract Sum in sufficient detail to facilitate continued

evaluation of Applications for Payment and progress reports. Break principal subcontract amounts down into several line items.

3. Round amounts off to the nearest whole dollar; the total shall equal the Contract Sum.
4. For each part of the Work where an Application for Payment may include materials or equipment, purchased or fabricated and stored, but not yet installed, provide separate line items on the Schedule of Values for initial cost of the materials, for the labor to install the materials, and for total installed value of that part of the Work.
5. Margins of Cost: Show line items for indirect costs, and margins on actual costs, only to the extent that such items will be listed individually in Applications for Payment. Each item in the Schedule of Values and Applications for Payment shall be complete including its total cost and proportionate share of general overhead and profit margin.
6. Schedule Updating: Update the Schedule of Values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Each Change Order will result in an additional line item.

1.4 APPLICATIONS FOR PAYMENT:

A. Each Application for Payment shall be consistent with previous applications and payments as certified by the Architect and paid for by the Owner.

1. The initial Application for Payment, the Application for Payment at time of Substantial Completion, and the final Application for Payment involve additional requirements.

B. Payment Application Times: A preliminary copy of each Application for Payment is to be submitted by the thirtieth day of each month for review. Three notarized final copies of each Application are to be submitted by the first Monday of each month for Owner approval by the third week of that month. Payments are to be made within two to three weeks following approval of the Application.

C. Payment Application Forms: Use AIA Document G 702 and Continuation Sheets G 703 as the form for Application for Payment.

D. Application Preparation: Complete every entry on the form, including notarization and execution by person authorized to sign legal documents on behalf of the Owner. Incomplete applications will be returned without action.

1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions have been made.
2. Include amounts of Change Orders and Construction Change Directives issued prior to the last day of the construction period covered by the application.

E. Transmittal: Submit three (3) executed copies of each Application for Payment to the Engineer by means ensuring receipt within 24 hours; each copy shall be complete, including waivers of lien and similar attachments, when required.

1. Transmit each copy with a transmittal form listing attachments, and recording appropriate information related to the application in a manner acceptable to the Engineer.

F. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of the first Application for Payment include the following:

1. List of subcontractors.
2. List of principal suppliers and fabricators.
3. Schedule of Values.
4. Contractor's Construction Schedule (preliminary if not final).
5. Schedule of principal products.

6. Submittal Schedule (preliminary if not final).
7. List of Contractor's staff assignments.
8. List of Contractor's principal consultants.
9. Copies of building permits
10. Copies of authorizations and licenses from governing authorities for performance of the Work.
11. Initial progress report.
12. Report of pre-construction meeting.
13. Certificates of insurance and insurance policies.
14. Performance and payment bonds.

G. Application for Payment at Substantial Completion: Following issuance of the Certificate of Substantial Completion, submit an Application for Payment; this application shall reflect any Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

H. Administrative actions and submittals that shall proceed or coincide with this application include:

1. Occupancy permits and similar approvals.
2. Warranties (guarantees) and maintenance agreements.
3. Test/adjust/balance records.
4. Maintenance instructions.
5. Start-up performance reports.
6. Change-over information related to Owner's occupancy, use, operation and maintenance.
7. Final cleaning.
8. Application for reduction of retainage, and consent of surety.
9. List of incomplete Work, recognized as exceptions to Certificate of Substantial Completion.

I. Final Payment Application: Administrative actions and submittals which must precede or coincide with submittal of the final payment Application for Payment include the following:

1. Completion of Project closeout requirements.
2. Completion of items specified for completion after Substantial Completion.
3. Assurance that unsettled claims will be settled.
4. Assurance that Work not complete and accepted will be completed without undue delay.
5. Transmittal of required Project construction records to Owner.
6. Removal of temporary facilities and services.
7. Removal of surplus materials, rubbish and similar elements.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01027

SECTION 01035 - MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification sections, apply to this section.

1.2 SUMMARY

A. This section specifies administrative and procedural requirements for handling and processing Contract modifications.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 1 Section "Unit Prices" for administrative requirements governing use of unit prices.
2. Division 1 Section "Submittals" for requirements for the Contractor's Construction Schedule.
3. Division 1 Section "Application for Payment" for administrative procedures governing applications for payment.
4. Division 1 Section "Product Substitutions" for administrative procedures for handling requests for substitutions made after award of the Contract.

1.3 MINOR CHANGES IN THE WORK

A. Supplemental instructions authorizing minor changes in the Work, not involving an adjustment to the Contract Sum or Contract Time, will be issued by the Engineer.

1.4 CHANGE ORDER PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Proposed changes in the Work that will require adjustment to the Contract Sum or Contract Time will be issued by the Engineer, with a detailed description of the proposed change and supplemental or revised Drawings and Specifications, if necessary.

1. Proposal requests issued by the Engineer are for information only. Do not consider an them instruction either to stop work in progress, or to execute the proposed change.
2. Unless otherwise indicated in the proposal request, within 14 days of receipt of the proposal request, submit to the Engineer for the Owner's review an estimate of cost necessary to execute the proposed change.
 - a. Include a list of quantities of products to be purchased and unit costs, along with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include a statement indicating the effect the proposed change in the Work will have on the Contract Time.

B. Contractor-Initiated Change Order Proposal Requests: When latent or other unforeseen conditions require modifications to the Contract, the Contractor may propose changes by submitting a request for a change to the Engineer.

1. Include a statement outlining the reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and Contract Time.
2. Include a list of quantities of products to be purchased and unit costs along with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Comply with requirements in Section "Product Substitutions" if the proposed change in the Work requires the substitution of one product or system for a product or system specified.

C. Proposal Request Form: Use AIA Document G 709 for Change Order Proposal Requests.

1.5 UNIT PRICES

A. Base each Change Order Proposal Request for a Unit Price cost adjustment solely on the amount of the actual work performed, except as noted in Section 01026.

1. When requested, prepare explanations and documentation to substantiate the quantities claimed.
2. Submit substantiation of a change in scope of work claimed in the Change Orders related to unit-price work.
3. The Owner reserves the right to establish the actual quantity of work-in-place by independent quantity survey, measure, or count.

B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit, within 20 days of receipt of the change order or construction change directive authorizing work to proceed. Claims submitted later than 20 days will be rejected.

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: When the Owner and Contractor are not in total agreement on the terms of a Change Order Proposal Request, the Engineer may issue a Construction Change Directive, instructing the Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. The Construction Change Directive will contain a complete description of the change in the Work and designate the method to be followed to determine change in the Contract Sum or 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 the change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

1.7 CHANGE ORDER PROCEDURES

A. Upon the Owner's approval of a Change Order Proposal Request, the Engineer will issue a Change Order for signatures of the Owner and Contractor, as provided in the Conditions of the Contract.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01035

SECTION 01040 - PROJECT COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and supervisory requirements necessary for Project coordination including, but not necessarily limited to:

1. Coordination.
2. Submittals
3. Contractor's Use of Premises
4. Owner Occupancy
5. Administrative and supervisory personnel.
6. General installation provisions.
7. Cleaning and protection.

B. Progress meetings, coordination meetings and pre-installation conferences are included in Section "Project Meetings".

C. Requirements for the Contractor's Construction Schedule are included in Section "Submittals".

1.3 COORDINATION

A. Coordination: Coordinate construction activities included under various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections of the Specifications that are dependent upon each other for proper installation, connection, and operation.

1. Where installation of one part of the Work is dependent on installation of other components, either before or after its own installation, schedule construction activities in the sequence required to obtain the best results.
2. Where availability of space is limited, coordinate installation of different components to assure maximum accessibility for required maintenance, service and repair.
 - a. Coordination diagrams showing space allocations in constricted areas for various trades are included in this section.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Where necessary, prepare memoranda for distribution to each party involved outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of schedules.

2. Installation and removal of temporary facilities.
3. Delivery and processing of submittals.
4. Progress meetings.
5. Project Close-out activities.

1.4 SUBMITTALS

A. Emergency contacts: Within 15 days of Notice to Proceed, submit a list of the Contractor's principal emergency contacts; identify individuals, their duties and responsibilities; list their telephone numbers on a 24 hour basis.

1.5 CONTRACTOR USE OF PREMISES

A. General: Limit use of the premises to construction activities in areas indicated; the premises are to be in continuous use and operation during the Work, allow for Owner occupancy and use by the public. Schedule all construction activities with the Construction Manager and the Owner to allow Owner's full use of the buildings and systems for normal educational process and normal operations.

1. Confine operations to areas within Contract limits indicated. Portions of the site beyond areas in which construction operations are indicated are not to be disturbed.
2. Keep driveways and entrances serving the premises clear and available to the Owner, Owner's employees, and students 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. Schedule deliveries to minimize the impact upon the Owner's deliveries.
3. At all times the contractor is to maintain a clear separation of Work area and the Owner, Owner's employees, and students. A physical barrier is to be erected to separate the Work area from the public areas..
4. Owner acknowledges the Contractor will require access to Owner-occupied areas, rooms, and systems, and intends to cooperate in making rooms and systems available for construction activities.
5. The Contractor shall notify the construction Manager and the Owner in advance of any requirements for access to any building outside of normal working hours. The Contractor is required to coordinate with the Avon by the Sea Borough's Construction Office and follow and obey all local work and noise ordinances.

B. Use of the Existing Premises: Repair damage caused by construction operations. Take all precautions necessary to protect the premises, its equipment, and its occupants during the construction period.

1. Schedule all activities so as to minimize disruption to the use of the Premises.
2. Provide advance notice of all construction activities to person or persons as designated by the Construction Manager.
3. Schedule all construction activities at the Site with the Construction Manager and Owner to avoid interference with Owner's operations and to meet specified completion dates. It is the responsibility of the Contractor to meet the completion schedule within the Owners Educational and summer activity schedule.
4. Coordinate construction activities with daily and semester calendars issued by the Owner to avoid interference with Owner's educational process and normal operations within the buildings and campus.
5. Extra payment for overtime outside normal working hours required to complete the project by the completion date will not be paid by the Owner. Contractor requiring overtime shall do so at his own cost.
6. Coordinate all interruptions of building services with Construction Manager and Owner, and obtain written approval of proposed schedule for interruptions from Construction

Manager and Owner.

7. If, at the Owner's opinion, any shutdown or interruption of services is not acceptable, schedule the shutdown or interruption of service after such shutdown or interruption would not effect normal operations.

8. Extra payment for overtime outside normal working hours required by any such shutdown or interruption of service will not be made by the Owner. The Contractor shall do so at his own cost and shall be responsible for extra costs incurred by his subcontractors.

C. Contractor Deliveries

1. **DO NOT DELIVER** materials unless the Contractor has means on site to unload, store, and handle all products being delivered.

2. **DO NOT DELIVER** materials via an overnight service such as UPS, DHL, Federal Express, US Mail, etc., or common carrier. All of these services must be sent to and offsite office or warehouse.

3. **DO NOT DELIVER** materials if the Contractor does not have a representative onsite to receive the delivery.

4. **NO DELIVERIES** will be received by the Districts employees. All deliveries that arrive to the school and not received by the Contractor will be refused and sent back to the sender. The Contractor is responsible for deliveries and responsible for any materials that may be lost as a result of misdirected goods. The Contractor is responsible to meet all schedules regardless of materials refused by the District.

D. Contractor Clean-up

1. Each Prime Contractor is responsible for daily clean-up and disposal of all debris created as a result of this contract. No debris shall be dispensed in Owner's dumpsters.

2. The Contractor is responsible for the restoration of any grass areas, flower beds, and plantings disturbed as part of this work. The contractor is required to fill any ruts with topsoil, reseed bare grass areas, and replace any plantings disturbed.

E. Security

1. All persons on site are required to sign in to a log every day. The Contractor will furnish the sign in log, will remain on school premises at all times. The sign in log will contain pertinent information such as name, address and phone and other information as the Owner may deem necessary for security.

2. All person on site will wear identification badges at all times. Badges will be furnished by the Owner. Lost badges will be replaced by the Owner at a cost of \$25.00 per badge per loss, to be paid by the Contractor.

3. No persons are permitted to work outside of designated areas without the Construction Manager's permission.

4. Any person failing to follow these security procedures will be removed from the site and not permitted to return.

1.04 OWNER OCCUPANCY

A. Owner does not intend to maintain summer programs during the period of this contract. However, administration personnel will be working in or around the existing building.

1. Owner acknowledges the Contractor will require access to Owner-occupied areas, rooms, and systems, and intends to cooperate in making rooms and systems available

for construction activities.

2. Notify Construction Manager and the Owner in advance of any requirements for access to any building outside normal working hours.

3. The Owner will occupy the premises during the entire period of construction for the conduct of its normal summer operations. Contractor must schedule and coordinate work in a pre-planned manner to minimize disruption to the normal operations of the school

4. The Owner will cooperate with providing access to the work site at other than normal working hours, including Saturday, Sunday, and should the contractor determine it advantageous to perform work during evening, night, or weekend hours. However, such arrangements must be approved and authorized in writing by the Owner's Representative.

PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION PROVISIONS

A. Inspection of Conditions: Require the Installer of each major component to inspect both the substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner. **Work placed over unacceptable substrates is the responsibility the Installer, regardless of who installed the substrate.**

B. Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.

C. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items.

D. Provide attachment and connection devices and methods necessary for securing Work. Secure Work true to line and level. Allow for expansion and building movement.

E. Visual Effects: Provide uniform joint widths in exposed Work. Arrange joints in exposed Work to obtain the best visual effect. Refer questionable choices to the Architect for final decision.

F. Recheck measurements and dimensions, before starting each installation.

G. Install each component during weather conditions and Project status that will ensure the best possible results. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration.

H. Coordinate temporary enclosures with required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.

I. Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the particular application indicated. Refer questionable mounting height decisions to the Architect for final decision.

3.2 CLEANING AND PROTECTION

A. During handling and installation, clean and protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure protection from damage or

deterioration at Substantial Completion.

B. Clean and maintain completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

C. Limiting Exposures: Supervise construction activities to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:

1. Excessive static or dynamic loading.
2. Excessive internal or external pressures.
3. Excessively high or low temperatures.
4. Thermal shock.
5. Excessively high or low humidity.
6. Air contamination or pollution.
7. Water or ice.
8. Solvents.
9. Chemicals.
10. Light.
11. Radiation.
12. Puncture.
13. Abrasion.
14. Heavy traffic.
15. Soiling, staining and corrosion.
16. Bacteria.
17. Rodent and insect infestation.
18. Combustion.
19. Electrical current.
20. High speed operation,
21. Improper lubrication,
22. Unusual wear or other misuse.
23. Contact between incompatible materials.
24. Destructive testing.
25. Misalignment.
26. Excessive weathering.
27. Unprotected storage.
28. Improper shipping or handling.
29. Theft.
30. Vandalism.

4.1 North Hanover Township and JB-MDL

A. Noise and Local Ordinances – The Contractor is responsible to obtain a copy of all local ordinances and obey, follow and coordinate with all local officials. This includes, and is not limited to, vehicle registrations and permits based on size, personnel sign in and registrations, access to site, etc.. A preconstruction meeting will be held with JB-MDL to review all required procedures.

SECTION 01040

SECTION 01045 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for cutting and patching.

B. Refer to other Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1. Requirements of this Section apply to mechanical and electrical installations. Refer to Division - 15 and 16 Section for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

2. Requirements of this Section apply to demolition of existing equipment. Refer to the Contract Documents for other requirements and limitations applicable to cutting, patching, and demolition of existing equipment.

C. Cutting and Patching refers to all removal and reinstallation of any existing finished and unfinished surface upon which the Contractor must access and install work.

1.3 SUBMITTALS

A. Cutting and Patching Proposal: Where approval of procedures for cutting and patching is required before proceeding, submit a proposal describing procedures well in advance of the time cutting and patching will be performed and request approval to proceed. Include the following information, as applicable, in the proposal:

1. Describe the extent of cutting and patching required and how it is to be performed; indicate why it cannot be avoided.
2. Describe anticipated results in terms of changes to existing construction; include changes to structural elements and operating components as well as changes in the building's appearance and other significant visual elements.
3. List products to be used and firms or entities that will perform Work.
4. Indicate dates when cutting and patching is to be performed.
5. List utilities that will be disturbed or affected, including those that will be relocated and those that will be temporarily out-of-service. Indicate how long service will be disrupted.
6. Where cutting and patching involves addition of reinforcement to structural elements, submit details and engineering calculations to show how reinforcement is integrated with the original structure.
7. Approval by the Engineer to proceed with cutting and patching does not waive the Engineer's right to later require complete removal and replacement of a part of the Work found to be unsatisfactory.

1.4 QUALITY ASSURANCE

A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would reduce their load-carrying capacity or load-deflection ratio.

B. Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance, or decreased operational life or safety.

C. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in the Engineer's opinion, reduce the building's aesthetic qualities, or result in visual evidence of cutting and patching. Remove and replace Work cut and patched in a visually unsatisfactory manner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Use materials that are identical to existing materials. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 - EXECUTION

3.1 INSPECTION

A. Before cutting existing surfaces, examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered.

1. Before proceeding, meet at the site with parties involved in cutting and patching. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.

C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Take all precautions necessary to avoid cutting existing pipe, conduit or ductwork serving the building, but scheduled to be removed or relocated until provisions have been made to bypass them.

3.3 PERFORMANCE

A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.

1. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.

B. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible review proposed procedures with the original installer; comply with the original installer's recommendations.

1. In general, where cutting is required use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.

3. Cut through concrete and masonry using a cutting machine such as a carborundum saw or diamond core drill.

4. Comply with requirements of applicable Sections of Division-2 where cutting and patching requires excavating and backfilling.

5. By-pass utility services such as pipe or conduit, before cutting, where services are shown or required to be removed, relocated or abandoned. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.

6. Remove all materials to be reinstalled and store those materials in a safe place.

C. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.

1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.

2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

3.4 CLEANING

A. Thoroughly clean areas and spaces where cutting and patching is performed, used as access, or affected by the process of cutting and patching. Remove completely paint, mortar, oils, putty and items of similar nature. Thoroughly clean piping, conduit and similar features before painting or other finishing is applied. Restore damaged pipe covering to its original condition.

END OF SECTION 01045

SECTION 01200 - PROJECT MEETINGS

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. This Section specifies administrative and procedural requirements for project meetings including but not limited to:

1. Pre-Construction Conference.
2. Pre-Installation Conferences.
3. Coordination Meetings.
4. Progress Meetings.

1.3 PRE-CONSTRUCTION CONFERENCE

A. The Construction Manager will schedule a pre-construction conference and organizational meeting at the Project site or other convenient location no later than 15 days after execution of the Agreement and prior to commencement of construction activities. The meeting will be conducted to review responsibilities and personnel assignments.

B. Attendees: The Owner, Owner's Representative, consultants, each Prime Contractor and its superintendent, major subcontractors, manufacturers, suppliers and other concerned parties shall each be represented at the conference by persons familiar with and authorized to conclude matters relating to the Work.

C. Agenda: Discuss items of significance that could affect progress including such topics as:

1. Tentative construction schedule.
2. Critical Work sequencing.
3. Designation of responsible personnel.
4. Procedures for processing field decisions and Change Orders.
5. Procedures for processing Applications for Payment.
6. Distribution of Contract Documents.
7. Submittal of Shop Drawings, Product Data and Samples.
8. Preparation of record documents.
9. Use of the premises.
10. Office, Work and storage areas.
11. Equipment deliveries and priorities.
12. Safety procedures.
13. First aid.
14. Security.
15. Housekeeping.
16. Working hours.

1.4 PROGRESS MEETINGS

A. Conduct progress meetings at the Project site at biweekly intervals. The Construction

Manager shall coordinate the meeting schedule and provide meeting minutes. Coordinate dates of meetings with preparation of the payment request.

B. Attendees: In addition to representatives of the Owner and Architect, each subcontractor, supplier or other entity concerned with current progress or involved in planning, coordination or performance of future activities shall be represented at these meetings by persons familiar with the Project and authorized to conclude matters relating to progress.

C. Agenda: Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the current status of the Project.

1. Contractor's Construction Schedule: Review progress since the last meeting. Determine where each activity is in relation to the Contractor's Construction Schedule, whether on time or ahead or behind schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

2. Review the present and future needs of each entity present, including such items as:

- a. Interface requirements.
- b. Time.
- c. Sequences.
- d. Deliveries.
- e. Off-site fabrication problems.
- f. Access.
- g. Site utilization.
- h. Temporary facilities and services.
- i. Hours of Work.
- j. Hazards and risks.
- k. Housekeeping.
- l. Quality and Work standards.
- m. Change Orders.
- n. Documentation of information for payment requests.

D. Reporting: No later than 3 days after each progress meeting date, distribute copies of minutes of the meeting to each party present and to other parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.

1. Schedule Updating: Revise the construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue the revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01200

SECTION 01300 - SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for submittals required for performance of the Work, including;

1. Submittal schedule.
2. Daily construction reports.
3. Shop Drawings.
4. Product Data.
5. Samples.

B. Administrative Submittals: Refer to other Division-1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to:

1. Permits.
2. Applications for payment.
3. Performance and payment bonds.
4. Insurance certificates.
5. List of Subcontractors.

C. The Schedule of Values submittal is included in Section "Applications for Payment."

1.3 SUBMITTAL PROCEDURES

A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.

1. Submit a minimum of three (3) copies of each submittal, for use by the Owner and Engineer, directly to the Engineer. Add to the above amount additional submittals required by the Contractor.
2. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that require sequential activity.
3. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.

a. The Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

4. Processing: Allow sufficient review time so that installation will not be delayed as a result of the time required to process submittals, including time for resubmittals.

- a. Allow 5 days for initial review. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. The Engineer will promptly advise the Contractor when a submittal being processed must be delayed for coordination.
- b. **No extension of Contract Time will be authorized because of failure to transmit submittals to the Engineer sufficiently in advance of the Work to permit processing.**

B. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.

- 1. Provide a space approximately 4" x 5" on the label or beside the title block on Shop Drawings to record the Contractor's review and approval markings and the action taken.
- 2. Include the following information on the label for processing and recording action taken.
 - a. Project name.
 - b. Date.
 - c. Name and address of Engineer.
 - d. Name and address of Contractor.
 - e. Name and address of supplier.
 - f. Name of manufacturer.
 - g. Number and title of appropriate Specification Section.
 - h. Drawing number and detail references, as appropriate.
- 3. Include Contractor's certification that review, verification of Products required, field dimensions, adjacent construction work, existing building lines and coordination of information is in accordance with the requirements of the Work and contract documents.
- 4. Identify variations from Contract Documents and project or system limitations which may be detrimental to successful performance of the completed work.

C. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Engineer using a transmittal form. Submittals received from sources other than the Contractor will be returned without action.

- 1. On the transmittal Record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including minor variations and limitations. Include Contractor's certification that information complies with Contract Document requirements.
- 2. Sequentially number transmittal forms. Resubmittals to have original number with alphabetic suffix.

1.5 PRODUCT DATA

A. Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams and performance curves. Where Product Data must be specially prepared because standard printed data is not suitable for use, submit as "Shop Drawings."

- 1. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate the applicable information. Include the following information:
 - a. Manufacturer's printed recommendations.
 - b. Compliance with recognized trade association standards.

- c. Compliance with recognized testing agency standards.
 - d. Application of testing agency labels and seals.
 - e. Notation of dimensions verified by field measurement.
 - f. Notation of coordination requirements.
2. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.
3. Submittals: Submit 4 copies of each required submittal; submit 4 copies where required for maintenance manuals.
- a. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.
4. Distribution: Furnish copies of final submittal to installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities. Show distribution on transmittal forms.
- a. Do not proceed with installation until an applicable copy of Product Data applicable is in the installer's possession.
 - b. Do not permit use of unmarked copies of Product Data in connection with construction.

1.6 SAMPLES

- A. Submit full-size, fully fabricated Samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture and pattern.

1.7 ENGINEER'S ACTION

- A. Except for submittals for record, information or similar purposes, where action and return is required or requested, the Engineer will return each submittal with the following designations:
 - 1. Reviewed: Further submission not required.
 - 2. Reviewed as Noted: Correction must be incorporated in final installation. Further submission is not required unless specifically noted.
 - 3. Review not Required: Placed in project files for information only.
 - 4. Revise and Resubmit: Make necessary changes and resubmit prior to fabrication.
 - 5. Rejected: Does not meet project requirements. Resubmit in accordance with Contract Documents.

PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION (Not Applicable).

END OF SECTION 01300

SECTION 01310 - CONSTRUCTION SCHEDULE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. General: This Section specifies administrative and procedural requirements for construction schedules required for proper performance of the Work.

B. Coordination: The General Work Contractor shall closely coordinate scheduling with Construction Manager

C. Schedules required include:

1. Preliminary Construction Schedule.
2. Contractor's Construction Schedule.

D. The schedule of values is included in Section "Applications for Payment."

E. Other schedules and submittals are included in the Section "Submittals".

1.3 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: The General Contractor shall prepare a Construction Schedule for the entire Project. The Schedule shall be a comprehensive, multi-sheet, integrated, fully developed horizontal bar-chart type schedule based on the Preliminary Construction Schedules and reflecting updating and feedback received from the Owner, Architect and Construction Manager. The construction schedule shall be submitted to the Construction Manager for approval.

1. Submit the schedule within 10 days of the date established for commencement of the Work.
2. Provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week.
3. Prepare the Schedule on a sheet, or series of sheets, of stable transparency, or other reproducible media, of sufficient width to show data clearly for the entire construction period.
4. Secure time commitments for performing critical elements of the Work from parties involved. Coordinate each element on the schedule with other portions of the Work; include minor elements involved in the overall sequence of the Work. Show each construction activity in proper sequence. Indicate graphically sequences necessary for completion of related portions of the Work.
5. Coordinate the Contractor's Construction Schedule with the schedule of values, list of

subcontracts, Submittal Schedule, progress reports, payment requests and other required schedules and reports.

6. Indicate completion of the Work in advance of the date established for Substantial Completion. Indicate Substantial Completion on the Schedule to allow ample time for the Architect's administrative procedures necessary for Certification of Substantial Completion.

C. Provide notations on the Schedule to show how the sequence of the Work is affected by the following:

1. Requirements for phased completion.
2. Work by separate Contractors.
3. Work by the Owner.
4. Pre-purchased materials.
5. Coordination with existing construction.
6. Limitations of continued occupancies.
7. Uninterruptible services.
8. Partial occupancy prior to Substantial Completion.
9. Site restrictions.
10. Provisions for future construction.
11. Seasonal variations.
12. Environmental control

D. Work Stages: Use crosshatched bars to indicate important stages of construction for each major portion of the Work. Such stages include, but are not necessarily limited to:

1. Subcontract awards.
2. Purchases.
3. Mockups.
4. Fabrication.
5. Sample testing.
6. Deliveries.
7. Installation.
8. Testing.
9. Adjusting.
10. Curing.
11. Start-up and placement into final use and operation.

E. Distribution: Following the Construction Manager's response to initial submittal of the Contractor's Construction Schedule, print and distribute copies to the Construction Manager, Architect, Owner, separate contractors, subcontractors, suppliers, fabricators, and other parties required to comply with scheduled dates.

1. Post copies of the Schedule in the Project meeting room and temporary field office.
2. When revisions are made, distribute the updated Schedule to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

F. Schedule Updating: Revise the Schedule immediately after each meeting or other activity, where revisions have been recognized or made and as directed by the Construction Manager. Issue the updated Schedule concurrently with report of each meeting.

1.4 SCHEDULE MILESTONE DATES

A. Each phase listed above must be completed by the specified dates. Failure to meet the milestone dates specified will be construed a contract default and subject to all remedies provide for in the General Conditions and Supplemental General Conditions, including but not limited to liquidated damages.

- 1. Commence Work (Notice to Proceed): May 29, 2019
- 2. Transmit All Project Submittals, Product Data and Samples by: June 30, 2019
- 3. Contract Renovations Work (Construction Schedule):
 - Start: June 20, 2019
 - Finish: (Temporary Certificate of Occupancy) August 30, 2019
- 4. Classroom Unit Ventilators & Adjacent Casework Installation & Finish
 - Start: June 20, 2020
 - Project Completion (Certificate of Occupancy): July 15, 2020

Please Note that the Contractor will be allowed to install the Classroom Units Ventilators and Associated Casework and Finish Items as Soon as Summer 2019, or During the 2019-2020 School Extended Breaks Pending Procurement and Delivery. Work Schedule during School Breaks must be Submitted and Approved by the Owner / Construction Manager. However, No Extension of Time or Additional Funds will be granted.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01310

SECTION 01500 - TEMPORARY FACILITIES

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. This Section specifies requirements for temporary services and facilities, including utilities, construction and support facilities, security and protection.

B. Temporary construction and support facilities required include but are not limited to:

1. Temporary electricity.
2. Temporary water.
3. Temporary weather protection.
4. Sanitary facilities.
5. Denaturing facilities and drains.
6. Temporary protection and enclosures.
7. Waste disposal services.
8. Construction aids and miscellaneous services and facilities.

D. Security and protection facilities, include but are not limited to:

1. Temporary fire protection.
2. Barricades, warning signs.
3. Environmental protection.
4. Overhead protection

1.3 QUALITY ASSURANCE

A. Regulations: Comply with industry standards and applicable laws and regulations if authorities having jurisdiction, including but not limited to:

1. Building Code requirements.
2. Health and safety regulations.
3. Utility company regulations.
4. Police, Fire Department and Rescue Squad rules.
5. Environmental protection regulations.
6. Freehold Regional Soil Conservation District
7. NJ Department of Environmental Protection

B. Standards: Comply with NAPA Code 241, "Building Construction and Demolition Operations", ANSI-A10 Series standards for "Safety Requirements for Construction and Demolition", and NECA Electrical Design "Temporary Electrical Facilities."

1. Refer to "Guidelines for Bid Conditions for Temporary Job Utilities and Services", prepared jointly by AGC and ASC, for industry recommendations.
2. Electrical Service: Comply with NEMA, NECA and UL standards and regulations for temporary electric service. Install service in compliance with National Electric Code

(NAPA 70).

C. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certifications and permits.

1.4 PROJECT CONDITIONS

A. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities, or permit them to interfere with progress. Do not allow hazardous dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide new materials. Provide materials suitable for the use intended.

B. Water: Provide potable water approved by local health authorities.

C. Open-Mesh Fencing: Chain link fencing 8'-0" high with steel fence posts.

D. Overhead protection: Provide overhead protection from falling materials at all required locations shown on Structures to be capable of supporting a uniform load of 100 pounds per square foot.

2.2 EQUIPMENT

A. General: Provide new equipment; if acceptable to the Construction Manager, undamaged, previously used equipment in serviceable condition may be used. Provide equipment suitable for use intended.

B. Electrical Outlets: Provide properly configured NEMA polarized outlets to prevent insertion of 110-120 volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button and pilot light, for connection of power tools and equipment.

C. Electrical Power Cords: Provide grounded extension cords; use "hard-service" cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords, if single lengths will not reach areas where construction activities are in progress.

D. Temporary Toilet Units: Provide self-contained single-occupant toilet units of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed with a glass fiber reinforced polyester shell or similar nonabsorbent material.

E. First Aid Supplies: Comply with governing regulations.

F. Fire Extinguishers: Provide hand-carried, portable UL-rated, class "A" fire extinguishers for temporary offices and similar spaces. In other locations provide hand-carried, portable, UL-rated, class "ABC" dry chemical extinguishers, or a combination of extinguishers of NAPA recommended classes for the exposures.

1. Comply with NAPA 10 and 241 for classification, extinguishing agent and size required by location and class of fire exposure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.

B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. 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. Electric Power Service: Electrical power may be obtained from existing facilities.

B. Water Service: Water service may be obtained from existing facilities.

3.3 TEMPORARY CONSTRUCTION AND SUPPORT FACILITIES INSTALLATION

A. Sanitary facilities include temporary toilets, wash facilities and drinking water fixtures. Comply with regulations and health codes for the type, number, location, operation and maintenance of fixtures and facilities. Install where facilities will best serve the Project's needs.

1. Provide toilet tissue, paper towels, paper cups and similar disposable materials for each facility. Provide covered waste containers for used material.

B. Toilets: **Use of the Owner's existing toilet facilities will be not permitted.**

C. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy. Use of pit-type privies will not be permitted.

D. Collection and Disposal of Waste: Collect waste from construction areas and elsewhere daily. Comply with requirements of NAPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than 7 days during normal weather or 3 days when the temperature is expected to rise above 80 deg F (27 deg C). Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material in a lawful manner.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Temporary Fire Protection: Install and maintain temporary fire protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with NAPA 10 "Standard for Portable Fire Extinguishers," and NAPA 241 "Standard for Safeguarding Construction, Alterations and Demolition Operations."

1. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor at or near each usable stairwell.

2. Store combustible materials in containers in fire-safe locations.

3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways and other access routes for fighting fires. Prohibit smoking in hazardous fire exposure areas.

4. Provide supervision of welding operations, combustion type temporary heating units, and similar sources of fire ignition.

B. Barricades, Warning Signs and Lights: Comply with standards and code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics and warning

signs to inform personnel and the public of the hazard being protected against. Where appropriate and needed provide lighting, including flashing red or amber lights.

C. Enclosure Fence: Prior to beginning any work, install an enclosure fence. Install in a manner that will prevent people, dogs and other animals from easily entering the site.

D. Security Enclosure and Lockup: Install substantial temporary enclosure of partially completed areas of construction. Provide locking entrances to prevent unauthorized entrance, vandalism, theft and similar violations of security.

1. Storage: Where materials and equipment must be stored, and are of value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of material to minimize the opportunity for theft and vandalism.

E. Environmental Protection: Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result. Avoid use of tools and equipment which produce harmful noise. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms near the site.

F. Overhead protection: Provide overhead protection from falling materials.

G. Temporary partitions: Prior to any construction activities, the Contractor will provide wood partitions (2 x 4 studs at 16" c/c) with plywood sheathing on the occupied side of every interior door adjacent to occupied areas including, but not limited to, the Gymnasium, the Trainer's Room, all adjoining corridors and fire exits. All openings must be sealed at all joints and be dust proof. Doors are to be hollow metal with lockable panic hardware and weather stripping. Provide keys for the Construction Manager and Owner. Provide exit signs and emergency signage as required by local officials. All inspections with local code and fire enforcement must be coordinated and approved by the Contractor prior to any work activities.

3.5 OPERATION, TERMINATION AND REMOVAL

A. Maintenance: Maintain facilities in good operating condition until removal.

B. Termination and Removal: Unless the Engineer requests that it be maintained longer, remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged Work, clean exposed surfaces and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of the Contractor.

END OF SECTION 01500

SECTION 01631 - PRODUCT SUBSTITUTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for handling requests for substitutions made after award of the Contract.

B. The Contractor's Construction Schedule and the Schedule of Submittals are included under Section "Submittals."

C. Standards: Refer to Section "Definitions and Standards" for applicability of industry standards to products specified.

D. Procedural requirements governing the Contractor's selection of products and product options are included under Section "Materials and Equipment."

1.3 DEFINITIONS

A. Definitions used in this Article are not intended to change or modify the meaning of other terms used in the Contract Documents.

B. Substitutions: Requests for changes in products, materials, equipment, and methods of construction required by Contract Documents proposed by the Contractor after award of the Contract are considered requests for "substitutions." The following are not considered substitutions:

1. Revisions to Contract Documents requested by the Owner or Engineer.
2. Specified options of products and construction methods included in Contract Documents.
3. The Contractor's determination of and compliance with governing regulations and orders issued by governing authorities.

1.4 SUBMITTALS

A. Substitution Request Submittal: Requests for substitution will be considered if received within 30 days after commencement of the Work and only if the "Equivalent Listing" form was submitted within 48 hours after the bid opening. Requests received more than 30 days after commencement of the Work may be considered or rejected at the discretion of the Engineer.

1. Submit 3 copies of each request for substitution for consideration. Submit requests in the form and in accordance with procedures required for Change Order proposals.
2. Identify the product, or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:

- a. Product Data, including Drawings and descriptions of products, fabrication and installation procedures.
- b. Samples, where applicable or requested.
- c. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect.
- d. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.
- e. A statement indicating the substitution's effect on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
- f. Cost information, including a proposal of the net change, if any in the Contract Sum.
- g. Certification by the Contractor that the substitution proposed is equal-to or better in every significant respect to that required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.

3. Engineer's Action: Within 5 days of receipt of the request for substitution, the Engineer will notify the Contractor of acceptance or rejection of the proposed substitution. If a decision on use of a proposed substitute cannot be made or obtained within the time allocated, use the product specified by name. Acceptance will be in the form of a Change Order. The Engineer will judge whether a substitution request is acceptable.

- a. Contractor shall not assume that a piece of equipment by a manufacturer submitted as a substitution will be automatically accepted. If the substituted material is considered to be unacceptable, the Contractor shall provide the equipment as originally specified.

4. By submitting a substitution, the Contractor automatically agrees to the following:

- a. The Owner shall be reimbursed by the Contractor for any additional costs incurred by the Engineer to review the substituted materials, in accordance with the then current hourly rates of the Engineer.
- b. The Owner shall be reimbursed by the Contractor for any additional costs incurred by the Engineer and his consultants for field or office conferences caused by the substituted materials, in accordance with the then current hourly rates of the Engineer.
- c. The consideration of substitutions does not obligate the Engineer to accept same.
- d. In the event that 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.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Conditions: The Contractor's substitution request will be received and considered by the Engineer when one or more of the following conditions are satisfied, as determined by the Engineer; otherwise requests will be returned without action except to record noncompliance with these requirements.

1. Extensive revisions to Contract Documents are not required.
2. Proposed changes are in keeping with the general intent of Contract Documents.
3. The request is timely, fully documented and properly submitted.
4. The specified product or method of construction cannot be provided within the Contract Time. The request will not be considered if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.
5. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
6. A substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other considerations of merit, after deducting offsetting responsibilities the Owner may be required to bear. Additional responsibilities for the Owner may include additional compensation to the Engineer for redesign and evaluation services, increased cost of other construction by the Owner or separate Contractors, and similar considerations.
7. The specified product or method of construction cannot be provided in a manner that is compatible with other materials, and where the Contractor certifies that the substitution will overcome the incompatibility.
8. The specified product or method of construction cannot be coordinated with other materials, and where the Contractor certifies that the proposed substitution can be coordinated.
9. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provide the required warranty.

B. The Contractor's submittal and Engineer's acceptance of Shop Drawings, Product Data or Samples that relate to construction activities not complying with the Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01631

SECTION 01700 - PROJECT CLOSE-OUT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for project closeout, including but not limited to:

1. Inspection procedures.
2. Project record document submittal.
3. Operating and maintenance manual submittal.
4. Submittal of warranties.
5. Final cleaning.

B. Closeout requirements for specific construction activities are included in the appropriate Sections in Divisions-2 through -16.

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, complete the following. List exceptions in the request.

1. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.

a. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.

2. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents.
3. Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities; include occupancy permits, operating certificates and similar releases.
4. Submit record drawings, maintenance manuals, final project photographs, damage or settlement survey, property survey, and similar final record information.
5. Deliver tools, spare parts, extra stock, and similar items.
6. Complete start-up testing of systems, and instruction of the Owner's operating and maintenance personnel. Discontinue or change over and remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.
7. Complete final clean up requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes.

B. Inspection Procedures: On receipt of a request for inspection, the Engineer will either proceed

with inspection or advise the Contractor of unfilled requirements. The Engineer will prepare the Certificate of Substantial Completion following inspection, or advise the Contractor of construction that must be completed or corrected before the certificate will be issued.

1. The Engineer will repeat inspection when requested and assured that the Work has been substantially completed.
2. Results of the completed inspection will form the basis of requirements for final acceptance.

1.4 FINAL ACCEPTANCE

A. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following. List exceptions in the request.

1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
2. Submit an updated final statement, accounting for final additional changes to the Contract Sum.
3. Submit a certified copy of the Engineer's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and the list has been endorsed and dated by the Engineer.
4. Submit final meter readings for utilities, a measured record of stored fuel, and similar data as of the date of Substantial Completion, or when the Owner took possession of and responsibility for corresponding elements of the Work.
5. Submit consent of surety to final payment.
6. Submit a final liquidated damages settlement statement.
7. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

B. Reinspection Procedure: The Engineer will reinspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except items whose completion has been delayed because of circumstances acceptable to the Engineer.

1. Upon completion of reinspection, the Engineer will prepare a certificate of final acceptance, or advise the Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.
2. If necessary, reinspection will be repeated. Reinspections by the Engineer will be charged to the Contractor at current hourly rates.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES

- A. Submit (in duplicate) the following forms:
- a. AIA G706, Contractor's Affidavit of Payment of Debts and Claims.
 - b. AiAG706A, Contractor's Affidavit of Release of Liens.
 - c. AiAG707, Consent of Surety to Final Payment.
 - d. Copies of all final inspection reports and certificates.

3.2 FINAL CLEANING

A. General: General cleaning during construction is required by the General Conditions.

B. Final Cleaning: General Work Contractor shall employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.

1. Clean the site of rubbish, litter and other foreign substances. Sweep paved areas broom clean; remove stains, spills and other foreign deposits. Rake disturbed grounds that are neither paved nor planted, to a smooth even-textured surface.

C. Removal of Protection: Remove temporary protection and facilities installed for protection of the Work during construction.

D. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove waste materials from the site and dispose of in a lawful manner.

1. Where extra materials of value remaining after completion of associated Work have become the Owner's property, arrange for disposition of these materials as directed.

END OF SECTION 01700

SECTION 01740 - WARRANTIES AND BONDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturer's standard warranties on products and special warranties.

1. Refer to the General Conditions for terms of the Contractor's special warranty of workmanship and materials.
2. General closeout requirements are included in Section "Project Closeout."
3. Specific requirements for warranties for the Work and products and installations that are specified to be warranted, are included in the individual Sections of Divisions-2 through -16.
4. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.

B. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

1.3 WARRANTY REQUIREMENTS

A. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.

B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.

D. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.

1. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract

Documents.

E. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

1.4 SUBMITTALS

A. Submit written warranties to the Engineer prior to the date certified for Substantial Completion. If the Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Engineer.

1. Regardless of when a designated portion of the Work is completed or occupied or used by the Owner, all warranties shall commence from the date of Substantial Completion.

B. When a special warranty is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner through the Engineer for approval prior to final execution.

1. Refer to individual Sections of Divisions-2 through -16 for specific content requirements, and particular requirements for submittal of special warranties.

C. Form of Submittal: At Final Completion compile three copies of each required warranty and bond properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer.

PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01740

Project Specifications

Renovations & Alterations **C.B. LAMB ELEMENTARY SCHOOL** PHASE 1

North Hanover School District

46 Schoolhouse Road
Wrightstown, New Jersey



NETTAARCHITECTS

1084 Route 22 West
Mountainside, New Jersey 07092

NJDOE Project No. 3650-040-19-1000

ISSUE FOR BID
15 APRIL 2019

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SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Demolition and removal of selected portions of building or structure.
- B. Related Requirements:
 - 1. Division 01 Section "Summary" for restrictions on the use of the premises, Owner-occupancy requirements, and phasing requirements.
 - 2. Division 01 Section "Execution" for cutting and patching procedures.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner.
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.5 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

- A. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property. Indicate proposed locations and construction of barriers.
- B. Predemolition Photographs or Video: Submit before Work begins.
- C. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

1.7 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

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/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

- B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.
- C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Engage a professional engineer to 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.
- F. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.
 - 1. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Arrange to shut off indicated utilities with utility companies.
 - 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 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. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - c. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

3.3 PREPARATION

- A. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.

3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 01 Section "Temporary Facilities and Controls."

B. Temporary Shoring: 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.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly.

B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- D. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Division 07 Section for Membrane Roofing" for new roofing requirements.
 - 1. Remove existing roof membrane, flashings, copings, and roof accessories.
 - 2. Remove existing roofing system down to substrate.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.7 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 035416 - HYDRAULIC CEMENT UNDERLAYMENT

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. Hydraulic-cement-based underlayment for use below interior floor coverings.
- B. Related Sections include the following:
 - 1. Division 09 Sections for patching and leveling compounds applied with floor coverings.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Plans indicating substrates, locations, and average depths of underlayment based on survey of substrate conditions.
- C. Manufacturer Certificates: Signed by manufacturers of both underlayment and floor covering system certifying that products are compatible.
- D. Qualification Data: For Installer.
- E. Minutes of preinstallation conference.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Installer who is approved by manufacturer for application of underlayment products required for this Project.
- B. Product Compatibility: Manufacturers of both underlayment and floor covering system certify in writing that products are compatible.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature and humidity, ventilation, and other conditions affecting underlayment performance.
 - 1. Place hydraulic-cement-based underlayments only when ambient temperature and temperature of substrates are between 50 and 80 deg F.

1.7 COORDINATION

- A. Coordinate application of underlayment with requirements of floor covering products, including adhesives, specified in Division 09 Sections, to ensure compatibility of products.

PART 2 - PRODUCTS

2.1 HYDRAULIC-CEMENT-BASED UNDERLAYMENTS

- A. Underlayment: Hydraulic-cement-based, polymer-modified, self-leveling product that can be applied in minimum uniform thicknesses of 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Ardex; K-15 Self-Leveling Underlayment Concrete.
 - b. Bonsal, W. R. Company; Self-Leveling Underlayment.
 - c. ChemRex; MBT Mastertop 110 Plus Underlayment; Sonneborn Sonocrete Sonoflow; Thoro Underlayment, Self-Leveling.
 - d. MAPEI Corporation; Ultraplan 1.
 - 3. Cement Binder: ASTM C 150, portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C 219.
 - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.
 - 5. Underlayment Additive: Resilient-emulsion product of underlayment manufacturer formulated for use with underlayment when applied to substrate and conditions indicated.
- B. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch; 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.
- D. Reinforcement: For underlayment applied to wood substrates, provide galvanized metal lath or other corrosion-resistant reinforcement recommended in writing by underlayment manufacturer.
- E. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.

- F. Corrosion-Resistant Coating: Recommended in writing by underlayment manufacturer for metal substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for conditions affecting performance.
 - 1. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: 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.
 - 1. Moisture Testing: Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates do not exceed a maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - 2. Install underlayment reinforcement recommended in writing by manufacturer.
- C. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

3.3 APPLICATION

- A. General: Mix and apply underlayment components according to manufacturer's written instructions.
 - 1. Close areas to traffic during underlayment application and for time period after application recommended in writing by manufacturer.
 - 2. Coordinate application of components to provide optimum underlayment-to-substrate and inter-coat adhesion.
 - 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. Apply underlayment to produce uniform, level surface.
 - 1. Apply a final layer without aggregate to produce surface.
 - 2. Feather edges to match adjacent floor elevations.

- D. Cure underlayment according to manufacturer's written instructions. Prevent contamination during application 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 035416

SECTION 042200 - CONCRETE UNIT MASONRY

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 concrete masonry units.
 - 2. Mortar and grout.
 - 3. Masonry joint reinforcement.
 - 4. Ties and anchors.
 - 5. Miscellaneous masonry accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type and size of the following:
 - 1. Masonry units.
 - 2. Cementitious materials. Include brand, type, and name of manufacturer.
 - 3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 - 4. Grout mixes. Include description of type and proportions of ingredients.
 - 5. Joint reinforcement.
 - 6. Anchors, ties, and metal accessories.
- B. Mix Designs: For each type of mortar. Include description of type and proportions of ingredients.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

- C. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

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 designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 PROJECT CONDITIONS

- A. 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 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.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
- B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners unless otherwise indicated.

B. CMUs: ASTM C 90.

1. Density Classification: Lightweight.
2. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.

2.3 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Aggregate for Mortar: ASTM C 144.

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 thick, use aggregate graded with 100 percent passing the No. 16 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.

E. Aggregate for Grout: ASTM C 404.

F. Water: Potable.

2.4 REINFORCEMENT

A. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.

1. Interior Walls: Hot-dip galvanized, carbon steel.
2. Wire Size for Side Rods: 0.148-inch diameter.
3. Wire Size for Cross Rods: 0.148-inch diameter.
4. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
5. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

B. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

2.5 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
 2. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- diameter, stainless-steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.
- C. Partition Top Anchors: 0.105-inch- thick metal plate with 3/8-inch- diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from stainless steel.
- D. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.
1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.
- 2.6 MISCELLANEOUS ANCHORS
- A. Anchor Bolts: Headed steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.
- B. Postinstalled Anchors: Torque-controlled expansion anchors.
1. Load Capacity: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 unless otherwise indicated.
- 2.7 MISCELLANEOUS MASONRY ACCESSORIES
- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- 2.8 MORTAR AND GROUT MIXES
- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
 2. Use portland cement-lime mortar unless otherwise indicated.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.
1. For interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
- D. Grout for Unit Masonry: Comply with ASTM C 476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 2. Proportion grout in accordance with ASTM C 476, Table 1.
 3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 2. Verify that foundations are within tolerances specified.
 3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Build chases and recesses to accommodate items specified in this and other Sections.
- B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar before laying fresh masonry.
- D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

- F. 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.

3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
 - 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 - 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
 - 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 - 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- C. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.6 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
 - 1. Space reinforcement not more than 16 inches o.c.
 - 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
 - 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
- 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 returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:
 - 1. Provide an open space not less than 1/2 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 - 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
 - 3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.8 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
 - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
 - 2. Install preformed control-joint gaskets designed to fit standard sash block.
 - 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
 - 4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

3.9 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.10 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 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."

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3. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042200

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Concealed steel reinforcement for toilet accessories and other wall mounted products and assemblies.
 - 2. Steel framing and supports for applications where framing and supports are not specified in other Sections.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of 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.

1.4 ACTION SUBMITTALS

- A. 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. Steel tube reinforcement for low partitions.
 - 2. Steel framing and supports for applications where framing and supports are not specified in other Sections.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code - Steel."

2. AWS D1.2, "Structural Welding Code - Aluminum."
3. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls 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 acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

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 A 36.
- C. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240 or ASTM A 666, Type 304.
- D. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- E. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- F. Steel Pipe: ASTM A 53, Standard Weight (Schedule 40) unless otherwise indicated.
- G. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
 1. Size of Channels: 1-5/8 by 1-5/8 inches.
- H. Cast Iron: Either gray iron, ASTM A 48, or malleable iron, ASTM A 47, unless otherwise indicated.
- I. Aluminum Plate and Sheet: ASTM B 209, Alloy 6061-T6.
- J. Aluminum Castings: ASTM B 26, Alloy 443.0-F.
- K. Bronze Castings: ASTM B 584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semired brass).

2.3 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.

2.4 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. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.5 FINISHES, GENERAL

- 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.

2.6 STEEL AND IRON FINISHES

- A. Shop prime iron and steel items unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
- B. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
 - 1. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- C. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.7 ALUMINUM FINISHES

- A. As-Fabricated Finish: AA-M12.

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.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

END OF SECTION 055000

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Wood blocking and nailers.
 - 2. Plywood backing panels.

1.3 DEFINITIONS

- A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NHLA: National Hardwood Lumber Association.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.

2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
3. Provide dressed lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 15 percent unless otherwise indicated.

2.2 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
1. Blocking.
 2. Nailers.
- B. 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.
- C. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.3 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: DOC PS 1, Exterior, AC, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.4 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Screws for Fastening to Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

- C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.
- D. Do not splice structural members between supports unless otherwise indicated.
- E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- F. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
 - 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
 - 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches 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 thickness.
- G. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- H. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
- I. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD

- 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.

END OF SECTION 061053

SECTION 064116 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Plastic-laminate-faced architectural cabinets, cubbies and casework items.
- 2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets and casework unless concealed within other construction before installation.

- B. Related Requirements:

- 1. Division 06 Section "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product, including, panel products, high-pressure decorative laminate,, and cabinet hardware and accessories.

- 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: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

- 1. Show details full size.
- 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
- 3. Show locations and sizes of cutouts and holes for electrical switches and outlets and other items installed in architectural plastic-laminate cabinets.

- C. Samples for Verification:

- 1. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish and specified edge material applied to one edge.
- 2. Thermoset decorative panels, 8 by 10 inches, for each color, pattern, and surface finish, with edge banding on one edge.
- 3. Exposed cabinet hardware and accessories, one unit for each type.

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.
- B. Installer Qualifications: Fabricator of products.
- C. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver cabinets and casework until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets and casework must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install cabinets and casework until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where cabinets and casework are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.
- C. Established Dimensions: Where cabinets and casework are indicated to fit to other construction, establish dimensions for areas where cabinets and casework are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 PLASTIC LAMINATE

- A. Basis of Design: Subject to compliance with requirements provide Basis of Design product as shown on Finish Schedule on Drawings or approved comparable product.
- B. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.

2.2 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS AND CASEWORK

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets and casework indicated for construction, finishes, installation, and other requirements.
 - 1. Provide labels from AWI certification program indicating that woodwork complies with requirements of grades specified.
 - 2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.
- B. Grade: Premium.
- C. Type of Construction: Frameless.
- D. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.
- E. Laminate Cladding for Exposed Surfaces:
 - 1. Horizontal Surfaces: Grade HGS.
 - 2. Vertical Surfaces: Grade HGS.
 - 3. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.
- F. Materials for Semi-exposed Surfaces:
 - 1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.
 - a. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
 - 2. Drawer Sides and Backs: Solid-hardwood lumber.
 - 3. Drawer Bottoms: Hardwood plywood.
- G. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.
- H. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
 - 1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.
- I. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. As indicated by laminate manufacturer's designations.
 - 2. Match Architect's sample for color, pattern and finish.
 - 3. As selected by Architect from laminate manufacturer's full range in the following categories:

2.3 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 5 to 10 percent.

2.4 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, 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.
 1. Use treated materials that comply with requirements of referenced woodworking 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.

2.5 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 100 degrees of opening.
- C. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.
- D. Shelf Rests: BHMA A156.9, B04013; metal.
- E. Drawer Slides: BHMA A156.9.
 1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer; type; zinc-plated steel with polymer rollers.
 2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
 3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 2.
 4. For drawers more than 3 inches high but not more than 6 inches high and not more than 24 inches wide, provide Grade 1.
 5. For trash bins not more than 20 inches high and 16 inches wide, provide Grade 1HD-100.
- F. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
 2. Bright Chromium Plated: BHMA 625 for brass or bronze base; BHMA 651 for steel base.
 3. Satin Stainless Steel: BHMA 630.
- G. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.6 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesive for Bonding Plastic Laminate: Un-pigmented contact cement.
 - 1. Adhesive for Bonding Edges: Hot-melt adhesive.

2.7 FABRICATION

- A. Fabricate cabinets and casework to dimensions, profiles, and details indicated.
- B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
 - 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
- C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition cabinets and casework to average prevailing humidity conditions in installation areas.
- B. Before installing cabinets and casework, examine shop-fabricated work for completion and complete work as required.

3.2 INSTALLATION

- A. Grade: Install cabinets and casework to comply with same grade as item to be installed.
- B. Assemble cabinets and casework and complete fabrication at Project site to the extent that it was not completed in the shop.
- C. Install cabinets and casework level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

- D. Scribe and cut cabinets and casework to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor cabinets and casework to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
 - 1. Use filler matching finish of items being installed.
- F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 - 2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets and casework, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets and casework on exposed and semi-exposed surfaces.

END OF SECTION 064116

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Glass-fiber blanket.
- B. Related Requirements:
 - 1. Division 09 Section "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.1 GLASS-FIBER BLANKET

- A. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:
 - 1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
 - 2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.
- B. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. CertainTeed Corporation.
- b. Johns Manville; a Berkshire Hathaway company.
- c. Owens Corning.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 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 clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.

3.4 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Penetrations in fire-resistance-rated walls.
 - 2. Penetrations in horizontal assemblies.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.
 - 1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

- B. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
 2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
 - b. Classification markings on penetration firestopping correspond to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.
- C. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers offering products that may be incorporated into the Work include, but are not necessarily limited to the following:
1. A/D Fire Protection Systems Inc.
 2. Grace Construction Products.
 3. Hilti, Inc.
 4. Johns Manville.
 5. 3M Fire Protection Products.
 6. Tremco, Inc.; Tremco Fire Protection Systems Group.
 7. USG Corporation.

2.2 PENETRATION FIRESTOPPING

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 - 1. Fire-resistance-rated walls include fire-barrier walls and fire partitions.
 - 2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 - 1. Horizontal assemblies include floors.
 - 2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
 - 3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
- D. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

3.4 IDENTIFICATION

- A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Designation of applicable testing and inspecting agency.
 - 4. Date of installation.
 - 5. Manufacturer's name.
 - 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections.
- B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.
- C. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.
- B. Firestopping with No Penetrating Items:
 - 1. UL-Classified Systems: C-AJ- 0001-0999.
- C. Firestopping for Metallic Pipes, Conduit, or Tubing:
 - 1. UL-Classified Systems: C-AJ- 1001-1999.
- D. Firestopping for Nonmetallic Pipe, Conduit, or Tubing:
 - 1. UL-Classified Systems: C-AJ- 2001-2999.

END OF SECTION 078413

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Mildew-resistant joint sealants.
 - 2. Latex joint sealants.

1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.5 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

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 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

2.3 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

2.4 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
 - 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. BASF Corporation; Construction Systems.
 - b. Construction Foam Products; a division of Nomaco, Inc.

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:
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. Glass.
- b. Porcelain enamel.
- c. 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.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. 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.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of 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.

3.6 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.
 1. Joint Locations:
 - a. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 2. Joint Sealant: Acrylic latex.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. 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.
 2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

SECTION 081213 - HOLLOW METAL FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes hollow-metal frames.
- B. Related Requirements:
 - 1. Division 08 Section "Flush Wood Doors" for wood doors installed in hollow-metal frames.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or 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.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.
 - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inchspace between each unit to permit air circulation.

PART 2 - PRODUCTS

2.1 INTERIOR FRAMES

- A. Construct interior frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Frames: SDI A250.8, Level 2.

1. Physical Performance: Level B according to SDI A250.4.
2. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
3. Construction: Knocked down.
4. Exposed Finish: Prime.

2.2 FRAME ANCHORS

A. Jamb Anchors:

1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.

2.3 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Frame Anchors: ASTM A 879, Commercial Steel (CS), 04Zcoating designation; mill phosphatized.
 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008 or ASTM A 1011, hot-dip galvanized according to ASTM A 153, Class B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153.

2.4 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 2. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
- C. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce frames to receive nontemplated, mortised, and surface-mounted hardware.
 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- D. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
 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 frames.
 4. Provide loose stops and moldings on inside of hollow-metal work.
 5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.5 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Drill and tap frames to receive non-templated, mortised, and surface-mounted hardware.

3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

- a. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - b. Install frames with removable stops located on secure side of opening.
 - c. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - d. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
2. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
 3. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.
1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081213

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Solid-core doors with wood-veneer faces.
- 2. Factory finishing flush wood doors.
- 3. Factory fitting flush wood doors to frames and factory machining for hardware.

- B. Related Requirements:

- 1. Division 08 Section "Hollow Metal Frames" for flush wood door frames.
- 2. Division 08 Section "Glazing" for glass view panels in flush wood doors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of door. Include details of core and edge construction and trim for openings, include fire rating information.

- B. Samples for Verification:

- 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish.
- 2. Corner sections of doors, approximately 8 by 10 inches, with door faces and edges representing actual materials to be used.
 - a. Provide Samples for each species of veneer and solid lumber required.
 - b. Finish veneer-faced door Samples with same materials proposed for factory-finished doors.
- 3. Frames for light openings, 6 inches long, for each material, type, and finish required.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.5 QUALITY ASSURANCE

- A. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons.
- C. Mark each door on bottom rail with opening number used on Shop Drawings.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

1.8 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. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
 - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
 - 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 - 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."
- B. WDMA I.S.1-A Performance Grade: Heavy Duty.
- C. Structural-Composite-Lumber-Core Doors:
 - 1. Structural Composite Lumber: WDMA I.S.10.
 - a. Screw Withdrawal, Face: 700 lbf.
 - b. Screw Withdrawal, Edge: 400 lbf.
- D. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
- E. Mineral-Core Doors:

1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware.
3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

2.2 VENEER-FACED DOORS FOR TRANSPARENT FINISH

- A. Manufacturer: Refer to Finish Schedule on drawings or approved equal.
- B. Interior Solid-Core Doors:
 1. Grade: Premium, with Grade AA faces.
 2. Species: Select white maple, unless otherwise indicated or shown.
 3. Match between Veneer Leaves: Book match.
 4. Assembly of Veneer Leaves on Door Faces: Center-balance match.
 5. Exposed Vertical Edges: Same species as faces or a compatible species - edge Type A.
 6. Core: Either glued wood stave or structural composite lumber.
 7. Construction: Five or seven plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.

2.3 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: Flush rectangular beads.
- 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. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

2.4 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 1. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.
 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.

2.5 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 - 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors.
- C. Factory finish doors that are indicated to receive transparent finish.
- D. Factory finish doors where indicated in schedules or on Drawings as factory finished.
- E. Transparent Finish:
 - 1. Grade: Premium.
 - 2. Finish: AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" System 5, conversion varnish,,,,,
 - 3. Finish: WDMA TR-4 conversion varnish,,
 - 4. Staining: Match Architect's sample.
 - 5. Sheen: Satin.

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 Division 08 Section "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.

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- 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 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Access doors and frames for walls and ceilings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details materials, individual components and profiles, and finishes.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Detail fabrication and installation of access doors and frames for each type of substrate.
- C. Samples: For each door face material, at least 3 by 5 inches in size, in specified finish.
- D. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

PART 2 - PRODUCTS

2.1 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.
- B. Flush Access Doors with Exposed Flanges:
 - 1. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.
 - 2. Door Size: Refer to Drawings.
 - 3. Stainless-Steel Sheet for Door: Nominal 0.062 inch, 16 gage.
 - a. Finish: No. 4.

4. Frame Material: Same material, thickness, and finish as door.
5. Hinges: Manufacturer's standard.

C. Hardware:

1. Lock: Cylinder.

2.2 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- C. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.
- E. Rolled-Stainless-Steel Floor Plate: ASTM A 793, manufacturer's standard finish.
- F. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304. Remove tool and die marks and stretch lines or blend into finish.
- G. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.
- H. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.
- I. Aluminum Sheet: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of Alloy 5005-H15; with minimum sheet thickness according to ANSI H35.2.
- J. Frame Anchors: Same type as door face.
- K. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.3 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.
 1. For concealed flanges with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.

2. 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.
3. Provide mounting holes in frames for attachment of units to metal framing.
4. Provide mounting holes in frame for attachment of masonry anchors.

D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

1. For cylinder locks, furnish two keys per lock and key all locks alike.
2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

E. Extruded Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that will come in contact with concrete.

2.4 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Steel and Metallic-Coated-Steel Finishes:

1. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
2. Factory Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry-film thickness of 1 mil for topcoat.

E. Stainless-Steel Finishes:

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.
 - 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.
 - c. Directional Satin Finish: No. 4.
3. Bright, Cold-Rolled, Unpolished Finish: No. 2B.

F. Aluminum Finishes:

1. Mill finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.3 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

SECTION 087100 – DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Commercial door hardware for the following:
 - 1. Swinging doors.
 - 2. Other doors to the extent indicated.
 - 3. Refer to Drawings for door hardware sets
- B. Door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
 - 2. Cylinders specified for doors in other sections.
- C. Related Sections:
 - 1. Division 08 Section “Flush Wood Doors”
 - 2. Division 08 Section “Hollow Metal and Frames”
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - 2. ICC/IBC - International Building Code.
 - 3. NFPA 70 - National Electrical Code.
 - 4. NFPA 80 - Fire Doors and Windows.
 - 5. NFPA 101 - Life Safety Code.
 - 6. NFPA 105 - Installation of Smoke Door Assemblies.
 - 7. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards:
 - 1. ANSI/BHMA Certified Product Standards - A156 Series
 - 2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Warranty information for each product.
 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Proof of Certification: Provide copy of manufacturer(s) official certification or accreditation document indicating proof of status as a qualified installer of Windstorm assemblies.
- D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- E. Informational Submittals:
1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.
- F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals.

1.4 QUALITY ASSURANCE

- A. **Manufacturers Qualifications:** Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. **Installer Qualifications:** A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- C. **Door Hardware Supplier Qualifications:** Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- D. **Source Limitations:** Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
 - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
- E. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- F. **Keying Conference:** Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
 - 1. Function of building, purpose of each area and degree of security required.
 - 2. Plans for existing and future key system expansion.
 - 3. Requirements for key control storage and software.
 - 4. Installation of permanent keys, cylinder cores and software.
 - 5. Address and requirements for delivery of keys.
- G. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling, and access control system hardware without additional in-field modifications.

1.7 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
 - 1. Structural failures including excessive deflection, cracking, or breakage.
 - 2. Faulty operation of the hardware.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 4. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
 - 1. Ten years for mortise locks and latches.
 - 2. Seven years for heavy duty cylindrical (bored) locks and latches.
 - 3. Twenty five years for manual surface door closer bodies.

1.8 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets on Drawings. Products are identified by using door hardware designations, as follows:
- C. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated at the end of Part 3.
- D. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

- A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.
 - 1. Quantity: Provide the following hinge quantity, unless otherwise indicated:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
 - 2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
 - 3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
 - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
 - 4. Hinge Options: Comply with the following where indicated in the Hardware Sets or on Drawings:
 - a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.
 - 5. Acceptable Manufacturers:
 - a. Hager Companies (HA).
 - b. McKinney Products (MK).

2.3 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years' experience designing secured master key systems and have on record a published security keying system policy.
- B. Cylinders: Original manufacturer cylinders complying with the following:
 - 1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.
 - 2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 - 3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
 - 4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
 - 5. Keyway: Match Facility Restricted Keyway.
- C. Key Quantity: Provide the following minimum number of keys:
 - 1. Change Keys per Cylinder: Two (2)
 - 2. Master Keys (per Master Key Level/Group): Five (5).
 - 3. Construction Keys (where required): Ten (10).
- D. Construction Keying: Provide construction master keyed cylinders.

2.4 MECHANICAL LOCKS AND LATCHING DEVICES

- A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 certified. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.
 - 1. Acceptable Manufacturers:
 - a. Corbin Russwin Hardware (RU).
 - b. Sargent Manufacturing (SA).
 - c. Schlage (SC).

2.5 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
 - 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: Provide manufacturer's special strike box fabricated for aluminum framing.
 - 4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.
- B. Standards: Comply with the following:
 - 1. Strikes for Mortise Locks and Latches: BHMA A156.13.

2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.5.
4. Dustproof Strikes: BHMA A156.16.

2.6 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.
2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.
4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates, and through-bolt and security type fasteners as required for proper installation.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.

1. Acceptable Manufacturers:
 - a. LCN Closers (LC).
 - b. Sargent Manufacturing (SA).
 - c. Norton Door Controls (NO).

2.7 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than

1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.

3. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:
 - a. Stainless Steel: 300 grade, 050-inch thick.
4. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
5. Acceptable Manufacturers:
 - a. Rockwood Manufacturing (RO).

2.8 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
 1. Acceptable Manufacturers:
 - a. Rockwood Manufacturing (RO).

2.9 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and UBC 7-2, Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Acceptable Manufacturers:
 - 1. National Guard Products (NG).
 - 2. Pemko Manufacturing (PE).
 - 3. Reese Enterprises, Inc. (RE).

2.10 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.11 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
 - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and 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 specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
- B. Manufacturer's Abbreviations:

- 1. MK - McKinney
- 4. RO - Rockwood
- 5. SA - Sargent
- 6. NO - Norton
- 7. PE - Pemko

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Glass for doors.
 - 2. Fire-protection-rated glazing.
 - 3. Glazing sealants and accessories.

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass products; 12 inches square.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of glass and glazing product, from manufacturer.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved by coated-glass manufacturer.

- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
- B. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 - 1. For 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. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
- 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. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.

1. Minimum Glass Thickness for Exterior Lites: 6 mm.

D. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.

B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

C. Heat-Strengthened Float Glass: ASTM C 1048, 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.

2.5 FIRE-PROTECTION-RATED GLAZING

A. Fire-Protection-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on positive-pressure testing according to NFPA 257 or UL 9, including the hose-stream test, and shall comply with NFPA 80.

1. Fire-protection-rated glazing required to have a fire-protection rating of 20 minutes shall be exempt from the 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 or not glazing has passed the hose-stream test; whether or not glazing meets 450 deg F (250 deg C) temperature-rise limitation; and the fire-resistance rating in minutes.

2.6 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Privacy Film: Provide translucent "white" privacy film for application to interior glazing where shown as manufactured by 3M or approved equal.

C. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

2.7 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
 - 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

2.8 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 C 920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.

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. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- E. Provide spacers for glass lites where length plus width is larger than 50 inches.
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- F. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- G. 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.
- H. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.5 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- 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 088000

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
 - 2. Suspension systems for interior gypsum ceilings and soffits.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

PART 2 - PRODUCTS

2.1 FRAMING SYSTEMS

- A. Steel Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners of equivalent minimum base-metal thickness.
 - 1. Minimum Base-Metal Thickness: 0.027 inch.
 - 2. Depth: As indicated on Drawings.
- B. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - 1. Minimum Base-Metal Thickness: 0.033 inch.
- C. Cold-Rolled Channel Bridging: Steel, 0.053-inch minimum base-metal thickness, with minimum 1/2-inch- wide flanges.

1. Depth: 1-1/2 inches.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.

D. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base-Metal Thickness: 0.033 inch.
2. Depth: As indicated on Drawings.

E. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch- wide flanges.

1. Depth: As indicated on Drawings or 3/4 inch.
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch.
3. Tie Wire: ASTM A 641, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.

F. Z-Shaped Furring: With slotted or non-slotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-metal thickness of 0.018 inch, and depth required to fit insulation thickness indicated.

2.2 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.

B. Hanger Attachments to Concrete:

1. Anchors: Capable of sustaining a load equal to 5 times that imposed as determined by ASTM E 488.
 - a. Type: Postinstalled, expansion anchor.
2. Powder-Actuated Fasteners: Capable of sustaining, a load equal to 10 times that imposed as determined by ASTM E 1190.

C. Wire Hangers: ASTM A 641, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch and minimum 1/2-inch- wide flanges.

1. Depth: 2-1/2 inches.

E. Furring Channels (Furring Members):

2.3 AUXILIARY MATERIALS

A. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide asphalt saturated organic felt or foam gasket.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 INSTALLING FRAMED ASSEMBLIES

- 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 (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 - 1. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 2. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 3. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 - 4. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

- E. Direct Furring:
 - 1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- F. Z-Furring Members:
 - 1. Erect insulation vertically and hold in place with Z-furring members spaced 24 inches 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 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 from corner and cut insulation to fit.
- G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.3 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - 3. Do not attach hangers to steel roof deck.
 - 4. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 - 5. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 - 6. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

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END OF SECTION 092216

SECTION 092500 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Interior gypsum board.
 - 2. Tile backing panels.

- B. Related Sections:

- 1. Division 06 Section "Rough Carpentry" for wood framing and furring that supports gypsum board.
 - 2. Division 07 Section "Thermal Insulation" for insulation and vapor retarders installed in assemblies that incorporate gypsum board.
 - 3. Division 09 Section "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board.
 - 4. Division 09 Painting Sections for primers applied to gypsum board surfaces.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Samples: For the following products:

- 1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.

1.4 QUALITY ASSURANCE

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

1.5 STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PANELS, GENERAL

- A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.2 INTERIOR GYPSUM BOARD

- A. General: Complying with ASTM C 36 or ASTM C 1396, as applicable to type of gypsum board indicated and whichever is more stringent.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Gypsum Co.
 - b. BPB America Inc.
 - c. G-P Gypsum.
 - d. Lafarge North America Inc.
 - e. National Gypsum Company.
 - f. USG Corporation.
- B. Regular Type:
 - 1. Thickness: 3/8 inch or 1/2 inch.
 - 2. Long Edges: Tapered.
- C. Type X:
 - 1. Thickness: 5/8 inch.
 - 2. Long Edges: Tapered.
- D. Type C:
 - 1. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
 - 2. Long Edges: Tapered.

- E. Flexible Type: Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.
 - 1. Thickness: 1/4 inch.
 - 2. Long Edges: Tapered.
- F. Ceiling Type: Manufactured to have more sag resistance than regular-type gypsum board.
 - 1. Thickness: 1/2 inch.
 - 2. Long Edges: Tapered.
- G. Abuse-Resistant Type: Manufactured to produce greater resistance to surface indentation, through-penetration (impact resistance), and abrasion than standard, regular-type and Type X gypsum board.
 - 1. Core: As indicated on Drawings.
 - 2. Long Edges: Tapered.
- H. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.
 - 1. Core: 5/8 inch, Type X.
 - 2. Long Edges: Tapered.

2.3 TILE BACKING PANELS

- A. Water-Resistant Gypsum Backing Board: ASTM C 630 or ASTM C 1396.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Gypsum Co.
 - b. BPB America Inc.
 - c. G-P Gypsum.
 - d. Lafarge North America Inc.
 - e. National Gypsum Company.
 - f. USG Corporation.
 - 2. Core: As indicated on Drawings.
- B. Glass-Mat, Water-Resistant Backing Board:
 - 1. Complying with ASTM C 1178.
 - a. Product: Subject to compliance with requirements, provide "DensShield Tile Guard" by G-P Gypsum, "GlasRoc" by CertainTeed or "e²XP" by National Gypsum, or equal.
 - 2. Core: As indicated on Drawings.
- C. Cementitious Backer Units: ANSI A118.9.
 - 1. Acceptable Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Custom Building Products; Wonderboard.

- b. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
 - c. USG Corporation; DUROCK Cement Board.
2. Thickness: As indicated on Drawings.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

- 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
- 2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. L-Bead: L-shaped; exposed long flange receives joint compound.
 - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - f. Expansion (control) joint.
 - g. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

- 1. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fry Reglet Corp.
 - b. Gordon, Inc.
 - c. Pittcon Industries.
- 2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.
- 3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475.

B. Joint Tape:

- 1. Interior Gypsum Wallboard: Paper.
- 2. Exterior Gypsum Soffit Board: Paper.
- 3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
- 4. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

- 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
- 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use 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 compound.
 4. Finish Coat: For third coat, use setting-type, sandable topping compound.
 5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound or high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.
- D. Joint Compound for Tile Backing Panels:
1. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.
 2. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
 3. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.6 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Acoustical Sealant: As specified in Division 07 Section "Joint Sealants."
- F. Thermal Insulation and Vapor Retarder: As specified in Division 07 Section "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. 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-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.
- B. 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 1 framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
 2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
 4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.
- C. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.
- D. Curved Surfaces:
1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch-long straight sections at ends of curves and tangent to them.
 2. For double-layer construction, fasten base layer to studs with screws 16 inches o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches o.c.
- 3.4 APPLYING TILE BACKING PANELS
- A. Water-Resistant Gypsum Backing Board: Install at showers, tubs, and where indicated. Install with 1/4-inch gap where panels abut other construction or penetrations.
 - B. Cementitious Backer Units: ANSI A108.11.
 - C. Areas Not Subject to Wetting: Install regular-type gypsum wallboard panels to produce a flat surface except at showers, tubs, and other locations indicated to receive water-resistant panels.
 - D. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints at locations indicated on Drawings and according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners, unless otherwise indicated.
 - 2. Bullnose Bead: Use where indicated.
 - 3. LC-Bead: Use at exposed panel edges.
 - 4. L-Bead: Use where indicated.
 - 5. Curved-Edge Cornerbead: Use at curved openings.
- D. Exterior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners.
 - 2. LC-Bead: Use at exposed panel edges.
- E. Aluminum Trim: Install in locations indicated on Drawings.

3.6 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Panels that are substrate for 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 other Division 09 Sections.
- E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.7 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

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2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092500

SECTION 093000 - TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Ceramic wall tile.
- 2. Stone thresholds.
- 3. Metal edge strips.

- B. Related Sections:

- 1. Division 06 Section "Miscellaneous Rough Carpentry" for plywood floor underlayment.
- 2. Division 07 Section "Joint Sealants" for sealing of joints in tile surfaces.
- 3. Division 09 Section "Gypsum Board" for gypsum board substrates.

1.3 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in "American National Standard Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

1.4 PERFORMANCE REQUIREMENTS

- A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:
 - 1. Level Surfaces: Minimum 0.60.
 - 2. Ramp Surfaces: Minimum 0.80.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples for Verification:
 - 1. Full-size units of each type and composition of tile and for each color and finish required.
 - 2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 inches square, but not fewer than 4 tiles. Use grout of type and in color or colors approved for completed Work.
 - 3. Full-size units of each type of trim and accessory.
 - 4. Stone thresholds in 6-inch lengths.
 - 5. Metal edge strips in 6-inch lengths.
- D. Qualification Data: For qualified Installer.
- E. Product Certificates: For each type of product, signed by product manufacturer.
- F. Material Test Reports: For each tile-setting and -grouting product.

1.6 QUALITY ASSURANCE

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from one source or producer.
 - 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.
- E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.8 PROJECT 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.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
 - 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 - 1. Provide tile complying with Standard grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA 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.
- E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.2 TILE PRODUCTS (FT1, WTA and WTB)

- A. Tile Type: Glazed wall tile.
 - 1. Manufacturers: Subject to compliance with requirements, provide products on Finish Schedule or approved equal.
 - 2. Composition: Porcelain ceramic.
 - 3. Module Size: As shown on Finish Schedule.
 - 4. Thickness: 1/4 inch.

5. Face: Plain with modified square edges or cushion edges.
6. Tile Color and Pattern: As selected by Architect from manufacturer's full range.
7. Grout Color: As selected by Architect from manufacturer's full range.
8. Mounting: Factory, back mounted.
9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile.

2.3 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
 1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.
- B. Marble Thresholds: ASTM C 503, with a minimum abrasion resistance of 10 per ASTM C 1353 or ASTM C 241 and with honed finish.
 1. Description: Uniform, fine- to medium-grained white stone with gray veining.
 2. Description: Match Architect's sample.

2.4 SETTING MATERIALS

- A. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.
 1. Manufacturers: Subject to compliance with requirements, provide products that may be incorporated into the Work manufactured by Laticrete International, Inc. or by one of the following:
 - a. Bonsal American; an Oldcastle company.
 - b. MAPEI Corporation.
 - c. TEC; a subsidiary of H. B. Fuller Company.
 2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.
 - a. For oversize wall tile applications provide "255 MultMax" by Laticrete International, Inc. or approved equal.
- B. Organic Adhesive: ANSI A136.1, Type I, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 1. Basis of Design Manufacturer: Subject to compliance with requirements, provide products that may be incorporated into the Work manufactured by Laticrete International, Inc. or by one of the following or approved equal:
 - a. Bonsal American; an Oldcastle company.
 - b. MAPEI Corporation.
 - c. TEC; a subsidiary of H. B. Fuller Company.

2.5 GROUT MATERIALS

- A. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate as required to produce color indicated.
- B. Standard Cement Grout: ANSI A118.6.
 - 1. Basis of Design Manufacturer: Subject to compliance with requirements, provide products that may be incorporated into the Work manufactured by Laticrete International, Inc. or by one of the following or approved equal:
 - a. Bonsal American; an Oldcastle company.
 - b. MAPEI Corporation.
 - c. TEC; a subsidiary of H. B. Fuller Company.
- C. Polymer-Modified Tile Grout: ANSI A118.7.
 - 1. Manufacturers: Subject to compliance with requirements, provide products that may be incorporated into the Work manufactured by Laticrete International, Inc. or by one of the following or approved equal:
 - a. Bonsal American; an Oldcastle company.
 - b. MAPEI Corporation.
 - c. TEC; a subsidiary of H. B. Fuller Company.

2.6 ELASTOMERIC SEALANTS

- A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Division 07 Section "Joint Sealants."

2.7 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. Temporary Protective Coating: Product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.
 - 1. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.
- C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- D. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following or approved equal:
 - a. Bonsal American; an Oldcastle company; Grout Sealer.

- b. Bostik, Inc.; CeramaSeal Grout & Tile Sealer.
- c. MAPEI Corporation; KER 003, Silicone Spray Sealer for Cementitious Tile Grout.
- d. TEC; a subsidiary of H. B. Fuller Company; TA-256 Penetrating Silicone Grout Sealer.

2.8 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 installed tile.
 - 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 bonded mortar bed or thin-set 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 thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 TILE INSTALLATION

- A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA 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 TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
- 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. 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.
- E. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Glazed Wall Tile: 1/16 inch.
- F. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- G. 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.
 - 2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."
- H. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
 - 1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-portland cement mortar (thin set).

2. Do not extend waterproofing or crack isolation membrane under thresholds set in latex-portland cement mortar. Fill joints between such thresholds and adjoining tile set on waterproofing or crack isolation membrane with elastomeric sealant.
- I. Metal Edge Strips: Install at locations indicated or 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.

3.4 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
1. Remove latex-portland cement 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. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.
- B. 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.
- C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.5 INTERIOR TILE INSTALLATION SCHEDULE

- A. Ceramic Floor Tile Installation: TCNA F113; thinset mortar
1. Thinset Mortar: Modified dry-set mortar.
 2. Grout: Standard sanded cement grout.
- B. Interior Wall Installations, Metal Studs or Furring:
1. Tile Installation W223: Organic adhesive on solid backing; TCNA W223.
 - a. Tile Type: Wall Tile as Scheduled or approved.
 - b. Grout: As recommended by manufacturer.
 2. Tile Installation W242: Organic adhesive on gypsum board; TCNA W242.
 - a. Tile Type: Wall Tile as Scheduled or approved.
 - b. Grout: Polymer-modified grout as recommended by manufacturer.
 3. Tile Installation W244: Thin-set mortar on cementitious backer units or fiber cement underlayment; TCNA W244.

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- a. Tile Type: Wall Tile as Scheduled or approved.
- b. Thin-Set Mortar: Latex- portland cement mortar.
- c. Grout: As recommended by manufacturer.

END OF SECTION 093000

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Acoustical panels and exposed suspension systems for ceilings.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
 - 1. Acoustical Panel: Set of full-size samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- long Samples of each type, finish, and color.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.
- B. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

1.5 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
 - 2. Smoke-Developed Index: 50 or less.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Panels: Full-size panels equal to 2 percent of quantity installed.
 - 2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages 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.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, 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 ACOUSTICAL PANELS, GENERAL

- A. Source Limitations:
 - 1. Acoustical Ceiling Panel: Obtain each type from single source from single manufacturer.
 - 2. Suspension System: Obtain each type from single source from single manufacturer.
- B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.
- C. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
 - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface according to ASTM E 795.

- D. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
 - 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.2 ACOUSTICAL PANELS

- A. Manufacturers: Subject to compliance with requirements, provide products as shown on Finish Schedule or approved equal.
- B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
 - 1. Type and Form: Type IV, mineral base with membrane-faced overlay; Form 2, water felted; with vinyl overlay on face.
- C. Color: White.
- D. Size and Thickness: As indicated in Finish Schedule on Drawings.

2.3 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
 - 1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- B. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
 - 1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
 - a. Type: Postinstalled expansion anchors.
 - b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
 - 2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.
- C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641, Class 1 zinc coating, soft temper.

2. Stainless-Steel Wire: ASTM A 580, Type 304, nonmagnetic.
3. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
4. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch-diameter wire.

- D. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.
- E. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

2.4 METAL SUSPENSION SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products as shown in Finish Schedule on Drawings, or approved equal.
- A. 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- wide metal caps on flanges.
1. Structural Classification: Heavy-duty system.
 2. End Condition of Cross Runners: Override (stepped) type.
 3. Face Design: Flat, flush.
 4. Cap Material: Cold-rolled steel or aluminum.
 5. Cap Finish: Painted white.

2.5 METAL EDGE MOLDINGS AND TRIM

- A. Manufacturers: Subject to compliance with requirements provide edge moldings from same manufacturer as suspension system.
- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
 2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
 3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
- C. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements and the following:

1. Aluminum Alloy: 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 aluminum extrusions complying with ASTM B 221 for Alloy and Temper 6063-T5.
2. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils. Comply with ASTM C 635 and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.6 ACOUSTICAL SEALANT

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 1. Acoustical Sealant for Exposed and Concealed Joints: Provide the following or approved equal:
 - a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
 - b. USG Corporation; SHEETROCK Acoustical Sealant.
- B. Acoustical Sealant: Manufacturer's standard sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 1. Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant.

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.
 1. 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, and comply with layout shown on reflected ceiling plans.

3.3 ACOUSTICAL PANEL INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.

2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures 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. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 7. Do not attach hangers to steel deck tabs.
 8. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 9. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical 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 o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. 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 a neat, precise fit.
1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
 2. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 3. 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.
 4. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.

3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

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END OF SECTION 095113

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Resilient base.
 - 2. Resilient molding accessories.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg. F or more than 90 deg. F.

1.6 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg. F or more than 95 deg. F, in spaces to receive resilient products during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.

- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg. F or more than 95 deg. F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

- A. Resilient Base:
 - 1. Manufacturers: Subject to compliance with requirements, provide product as shown on Finish Schedule or approved equal.
- B. Resilient Base Standard: ASTM F 1861.
 - 1. Material Requirement: Type TV (vinyl, thermoplastic).
 - 2. Manufacturing Method: Group I (solid, homogeneous).
 - 3. Style: Cove (base with toe) Straight (flat or toeless).
- C. Minimum Thickness: 0.125 inch.
- D. Height: As indicated on Drawings.
- E. Lengths: Cut lengths 48 inches long or coils in manufacturer's standard length.
- F. Outside Corners: Job formed or preformed.
- G. Inside Corners: Job formed or preformed.
- H. Finish: Satin.

2.2 RESILIENT MOLDING ACCESSORY

- A. Resilient Molding Accessory:
 - 1. Manufacturers: Subject to compliance with requirements, provide resilient molding accessories by accessory manufacturer or approved equal.
- B. Description: Cap for cove resilient floor covering, Reducer strip for resilient floor covering, Transition strips.

- C. Material: Vinyl.
- D. Profile and Dimensions: As indicated.

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 manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
- C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.
- D. Floor Polish: Provide protective liquid floor polish products as recommended by resilient stair tread manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Accessories: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
 - 4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.

- b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until they are same temperature as the space where they are to be installed.
 - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible.

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 carpet that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

- B. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.

- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

- D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.
 - 1. Apply two coat(s).

- E. Cover resilient products 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. Solid vinyl floor tile.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: Full-size units of each color and pattern of floor tile required.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.
 - 1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg. F Store floor tiles on flat surfaces.

1.7 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg. F or more than 95 deg. F, in spaces to receive floor tile during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.

- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg. F or more than 95 deg. F.
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 SOLID VINYL FLOOR TILE

- A. Basis of Design Manufacturers and Products: Subject to compliance with requirements, provide product indicated on Finish Schedule on Drawings or approved comparable product.
- B. Tile Standard: ASTM F 1700.
 - 1. Class: Class I, monolithic vinyl tile.
 - 2. Type: A, smooth surface.
- C. Thickness: 0.125 inch, unless otherwise indicated.
- D. Size: 18 by 18 inches, unless otherwise indicated.
- E. Colors and Patterns: As indicated by manufacturer's designations.

2.3 INSTALLATION MATERIALS

- A. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 - 4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:
 - a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until they are the same temperature as the space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - 1. Lay tiles in pattern indicated.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. 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 exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Joint Sealant: Apply sealant to resilient terrazzo floor tile perimeter and around columns, at door frames, and at other joints and penetrations.
- E. Sealers and Finish Coats: Remove soil, visible adhesive, and surface blemishes from resilient terrazzo floor tile surfaces before applying liquid cleaners, sealers, and finish products.
 - 1. Sealer: Apply two base coats of liquid sealer.
 - 2. Finish: Apply two coats of liquid floor finish.
- F. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Steel.
- 2. Wood.
- 3. Gypsum board.

- B. Related Sections:

- 1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
- 2. Division 08 Sections for factory priming doors with primers specified in this Section.

1.3 DEFINITIONS

- A. Gloss Level 1 (Flat): Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 2 (High Side Sheen Flat): Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 3 (Eggshell): 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 5 (Semi-Gloss): 35 to 70 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Initial Selection: For each type of topcoat product.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.

2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Manufacturers and Products: Subject to compliance with requirements, provide product indicated on Finish Schedule on Drawings or approved comparable product.

2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

2.3 PRIMERS/SEALERS

- A. Primer Sealer, Latex, Interior: MPI #50.
 1. VOC Content: E Range of E3.
 2. Environmental Performance Rating: EPR 3.
- B. Primer Sealer, Latex, Interior, Wood: MPI #39.
 1. VOC Content: E Range of E3
 2. Environmental Performance Rating: EPR 3.
- C. Primer Sealer, Rust-Inhibitive, Water Based, Metal: MPI #107.
 1. VOC Content: E Range of E3.
 2. Environmental Performance Rating: EPR 3.
- D. Primer Sealer, Galvanized, Water Based, Metal: MPI #134.

1. VOC Content: E Range of E3.
2. Environmental Performance Rating: EPR 3.

2.4 WATER-BASED PAINTS

- A. Latex, Interior, Flat, (Gloss Level 1): MPI #53.
 1. VOC Content: E Range of E3.
 2. Environmental Performance Rating: EPR 4.5.
- B. Latex, Interior, Low Sheen, (Gloss Level 2): MPI #44.
 1. VOC Content: E Range of E3.
 2. Environmental Performance Rating: EPR 4.5.
- C. Latex, Interior, Eggshell (Gloss Level 3): MPI #52.
 1. VOC Content: E Range of E3.
 2. Environmental Performance Rating: EPR 4.5.
- D. Latex, Interior, Semi-Gloss, (Gloss Level 5): MPI #54.
 1. VOC Content: E Range of E3.
 2. Environmental Performance Rating: EPR 4.5.

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. Wood: 15 percent.
 2. Gypsum Board: 12 percent.
 3. Concrete: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. 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. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
 - 2. SSPC-SP 3, "Power Tool Cleaning."
- F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- H. Wood Substrates:
 - 1. Sand surfaces that will be exposed to view, and dust off.
 - 2. Prime edges, ends, faces, undersides, and backsides of wood.
 - 3. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. Paint the following work where exposed in equipment rooms:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Pipe hangers and supports.
 - d. Metal conduit.
 2. Paint the following work where exposed in occupied spaces:
 - a. Uninsulated metal piping.
 - b. Pipe hangers and supports.
 - c. Metal conduit.
 - d. 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 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

A. Steel Substrates: (Gloss Level 5)

1. Institutional Low-Odor/VOC Latex System

- a. Prime Coat: Primer, rust-inhibitive, water based MPI #107.
- b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
- c. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3), MPI #145.
- d. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5), MPI #147.

2. Epoxy-Modified Latex System MPI INT 5.1K:

- a. Prime Coat: Primer, rust inhibitive, water based, MPI #107.
- b. Topcoat: Epoxy-modified latex, semi-gloss (MPI Gloss Level 5), MPI #215.

B. Galvanized-Metal Substrates:

1. Latex over Waterborne Primer System:

- a. Prime Coat: Primer, galvanized, water based, MPI #134.
- b. Intermediate Coat: Latex, interior, matching topcoat.
- c. Topcoat: Latex, interior, flat, (Gloss Level 1), MPI #53.
- d. Topcoat: Latex, interior, (Gloss Level 3), MPI #52.
- e. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5), MPI #54.

C. Gypsum Board Substrates: MPI INT 9.2M.

1. Latex System:

- a. Prime Coat: Primer sealer, latex, interior, MPI #50.
- b. Intermediate Coat: Latex, interior, matching topcoat.
- c. Topcoat: Latex, interior, flat, (Gloss Level 1), MPI #53 (ceilings).
- d. Topcoat: Latex, interior, (Gloss Level 3), MPI #52 (walls).

END OF SECTION 099123

SECTION 101100 - VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Visual display board assemblies.
 - 2. Display rails.
 - 3. Tackable strips.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings 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.
- B. Field Measurements: Verify actual dimensions of construction contiguous with visual display units by field measurements before fabrication.

1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of visual display unit from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 50 or less.

2.3 VISUAL DISPLAY BOARD ASSEMBLY

- 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. AJW Architectural Products
 2. Marsh Industries
 3. Claridge Products
- B. Visual Display Board Assembly: factory fabricated.
 1. Assembly: Markerboard.
 2. Corners: Square.
 3. Width: As indicated on Drawings.
 4. Height: As indicated on Drawings.
 5. Mounting Method: Direct to wall.
- C. Markerboard Panel: Porcelain-enamel-faced markerboard panel on core indicated.
 1. Color: White.
- D. Aluminum Frames: Fabricated from not less than 0.062-inch-thick, extruded aluminum; standard size and shape.
 1. Aluminum Finish: Clear anodic.
- E. Joints: Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect.
- F. Chalktray: Manufacturer's standard; continuous.
 1. Box Type: Extruded aluminum with slanted front, grooved tray, and cast-aluminum end closures.
 2. Solid Type: Extruded aluminum with ribbed section and smoothly curved exposed ends.

2.4 DISPLAY RAILS

- 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. Display Rail: Manufacturer's standard rail with plastic-impregnated-cork insert.
 - 1. Finish: Natural oak.
- C. Size: 1 inch high by length indicated on Drawings.
- D. End Stops: Aluminum.

2.5 MARKERBOARD PANELS

- A. Porcelain-Enamel Markerboard Panels: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction, consisting of moisture-barrier backing, core material, and porcelain-enamel face sheet with high-gloss finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive.
 - 1. Face Sheet Thickness: 0.021 inch uncoated base metal thickness.
 - 2. Manufacturer's Standard Core: Minimum 1/4 inch thick, with manufacturer's standard moisture-barrier backing.
 - 3. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

2.6 MATERIALS

- A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.
- B. Natural-Cork Sheet Tack Boards and Tackable Strips: Seamless, single-layer, compressed fine-grain cork sheet; bulletin board quality; face sanded for natural finish with surface-burning characteristics indicated.
- C. Hardboard: ANSI A135.4, tempered.
- D. Medium-Density Fiberboard: ANSI A208.2.
- E. Fiberboard: ASTM C 208 cellulosic fiber insulating board.
- F. Extruded Aluminum: ASTM B 221, Alloy 6063.
- G. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by visual display unit manufacturer.

2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. 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 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.

2.8 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine walls and partitions for proper preparation and backing for visual display units.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.
- C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.

3.3 INSTALLATION

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- B. Factory-Fabricated Visual Display Board Assemblies: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than 16 inches o.c.. Secure tops and bottoms of boards to walls.
- C. Visual Display Board Assembly Mounting Heights: Install visual display units at mounting heights indicated on Drawings, or if not indicated, at heights indicated below.
 - 1. Mounting Height: 36 inches above finished floor to top of chalktray.
- D. Display Rails and Tack strips: Install rails at mounting heights indicated on Drawings. Attach to wall surface with fasteners at not more than 16 inches o.c.

3.4 CLEANING AND PROTECTION

- A. Clean visual display units according to manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display units after installation and cleaning.

END OF SECTION 101100

SECTION 101423 - PANEL SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Room-identification signs.

1.3 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.4 COORDINATION

- A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
 - 1. Room-Identification Signs: Full-size Sample.
- C. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

- B. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for signs.

2.2 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 backing sheet to produce composite sheet.
 - a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.
 - b. Surface-Applied Graphics: Applied vinyl film.
 - c. Color(s): As selected by Architect from manufacturer's full range.
 - 2. Sign-Panel Perimeter: Finish edges smooth.
 - a. Edge Condition: Square cut.
 - 3. Mounting: Manufacturer's standard method for substrates indicated with.
 - 4. Text and Typeface: Accessible raised characters and Braille typeface matching school standard. Finish raised characters to contrast with background color, and finish Braille to match background color.

2.3 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:
 - 1. Sign Mounting Fasteners:
 - a. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.
 - 2. Inserts: Furnish inserts to be set by other trades into concrete or masonry work.
- B. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

2.4 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 - 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 - 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 - 3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 - 4. Internally brace signs for stability and for securing fasteners.

5. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
- 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-Engraved Graphics: Reverse engrave 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. Shop- and Subsurface-Applied Vinyl: Align vinyl film in final position and apply to surface. Firmly press film from the middle outward to obtain good bond without blisters or fishmouths.
- E. Signs with Changeable Message Capability: Fabricate signs to allow insertion of changeable messages as follows:
 1. For snap-in changeable inserts beneath removable face sheet, furnish one suction or other device to assist in removing face sheet. Furnish initial changeable insert. Subsequent changeable inserts are by Owner.
 2. For slide-in changeable inserts, fabricate slot without burrs or constrictions that inhibit function. Furnish initial changeable insert. Subsequent changeable inserts are by Owner.

2.5 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Verify that anchor inserts are correctly sized and located to accommodate signs.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Room-Identification Signs and Other Accessible Signage: Install in locations on walls as indicated, according to accessibility standard.
- C. Mounting Methods:
1. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
 2. 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.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101423

SECTION 102800 - TOILET ROOM ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Toilet accessories as shown and scheduled.
 - 2. Miscellaneous accessories.

1.3 QUALITY ASSURANCE

- A. Accessory Locations: Coordinate accessory locations with other work to avoid interference and to assure proper anchorage, operation and servicing of accessory units.
- B. Inserts and Anchorages: Furnish inserts and anchoring devices which must be set in other work and coordinate their delivery to avoid delay.
- C. Products: Provide products of same manufacturer for each type of accessory unit and for units exposed in same areas.
- D. Code Requirements: Provide grab bars of types, capable of sustaining loads, as required by authorities having jurisdiction.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data, catalogue cuts and installation instructions for each toilet accessory.
- B. Setting Drawings: Provide setting drawings, templates, instructions, and directions for installation of anchorage devices in other work.
- C. Samples: Submit samples of toilet accessories as requested by Architect.

1.5 SYSTEM PERFORMANCE

- A. Grab bars in handicap toilets shall be capable of supporting 250 pounds for 5 minutes. Reinforce support system to achieve great rigidity so that glass wall panels do not break.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver accessories to the site, ready for use, in the manufacturer's original and unopened containers and packaging, bearing labels as to type or material, manufacturer's name and brand name.
- B. Store and handle accessories in accordance with manufacturer's instructions.
- C. Remove materials which are disfigured, scratched or not suitable and replace with new materials.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Stainless Steel: AISI Type 302/304, with polished No. 4 finish, 22 gauge minimum, unless otherwise indicated.
- B. Brass: Leaded and unleaded, flat products, rods, shapes, forgings, and flat products with finished edges.
- C. Chromium Plating: Nickel and chromium electro-deposited on base metal, ASTM B456, Type SC 2.
- D. Galvanized Steel Sheet: ASTM A527, G60.
- E. Fasteners, General: No exposed fastening devices permitted on exposed frames.
 - 1. Exposed Fasteners: Match finishes on which they are being used.
 - 2. Concealed Fasteners: Galvanized or cadmium plated.

2.2 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products as scheduled on the Finish Schedule or equal.

2.3 FABRICATION

- A. Stamped names or labels on exposed faces of toilet accessory units are not permitted. Unobtrusive labels on surfaces not exposed to view are acceptable.
- B. Fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with continuous stainless steel piano hinge. Provide concealed anchorage.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102800

SECTION 122113 - HORIZONTAL LOUVER BLINDS

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. Horizontal louver blinds with aluminum slats.

- B. Related Requirements:

- 1. Division 06 Section "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting horizontal louver blinds and accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Samples for Verification: For each type and color of horizontal louver blind indicated.

- 1. Slat: Not less than 12 inches long.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver horizontal louver blinds in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Do not install horizontal louver blinds until construction and wet 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 horizontal louver blinds are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain horizontal louver blinds from single source from single manufacturer.

2.2 HORIZONTAL LOUVER BLINDS, ALUMINUM SLATS

- A. Slats: Aluminum; alloy and temper recommended by producer for type of use and finish indicated; with crowned profile and radius corners.

- 1. Width: 1/2 to 5/8 inch.
- 2. Thickness: Manufacturer's standard.
- 3. Spacing: Manufacturer's standard.
- 4. Finish: Ionized antistatic, dust-repellent, baked polyester finish.

- B. Headrail: Formed steel or extruded aluminum; long edges returned or rolled. Headrails fully enclose operating mechanisms on three sides.

- 1. Capacity: One blind per headrail unless otherwise indicated.
- 2. Ends: Manufacturer's standard capped or plugged.
- 3. Manual Lift Mechanism:
 - a. Lift-Cord Lock: Variable; stops lift cord at user-selected position within blind full operating range.
 - b. Operator: Extension of lift cord(s) through lift-cord lock mechanism to form cord pull.
- 4. Manual Tilt Mechanism: Enclosed worm-gear mechanism and linkage rod that adjusts ladders.
 - a. Tilt: Full.
 - b. Operator: Clear-plastic wand.
- 5. Manual Lift-Operator and Tilt-Operator Lengths: Manufacturer's standard.
- 6. Manual Lift-Operator and Tilt-Operator Locations: Manufacturer's standard unless otherwise indicated.

- C. Bottom Rail: Formed-steel or extruded-aluminum tube that secures and protects ends of ladders and lift cords and has plastic- or metal-capped ends.

- 1. Type: Manufacturer's standard.

- D. Lift Cords: Manufacturer's standard braided cord.

- E. Ladders: Evenly spaced across headrail at spacing that prevents long-term slat sag.

- 1. Type: Braided cord.

- F. Mounting Brackets: With spacers and shims required for blind placement and alignment indicated.

- 1. Type: As indicated.
- 2. Intermediate Support: Provide intermediate support brackets to produce support spacing recommended by blind manufacturer for weight and size of blind.

G. Colors, Textures, Patterns, and Gloss:

1. Slats: As selected by Architect from manufacturer's full range.

2.3 HORIZONTAL LOUVER BLIND FABRICATION

A. Product Safety Standard: Fabricate horizontal louver blinds to comply with WCMA A 100.1 including requirements for corded, flexible, looped devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which blind is installed less 1/4 inch per side or 1/2 inch total, plus or minus 1/8 inch. Length equal to head-to-sill dimension of opening in which blind is installed less 1/4 inch, plus or minus 1/8 inch.

C. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.

1. Lift-and-Tilt Mechanisms: With permanently lubricated moving parts.

D. Mounting and Intermediate Brackets: Designed for removal and reinstallation of blind without damaging blind and adjacent surfaces, for supporting blind components, and for bracket positions and blind placement indicated.

E. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to brackets and adjoining construction; type designed for securing to supporting substrate; and supporting blinds and accessories under conditions of normal use.

F. Color-Coated Finish:

1. Metal: For components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

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.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install horizontal louver blinds level and plumb, aligned and centered on openings, and aligned with adjacent units according to manufacturer's written instructions.

1. Locate so exterior slat edges are not closer than 1 inch from interior faces of glass and not closer than 1/2 inch from interior faces of glazing frames through full operating ranges of blinds.
2. Install mounting and intermediate brackets to prevent deflection of headrails.
3. Install with clearances that prevent interference with adjacent blinds, adjacent construction, and operating hardware of glazed openings, other window treatments, and similar building components and furnishings.

3.3 ADJUSTING

- A. Adjust horizontal louver blinds to operate free of binding or malfunction through full operating ranges.

3.4 CLEANING AND PROTECTION

- A. Clean horizontal louver blind surfaces after installation according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer and that ensures that horizontal louver blinds are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged horizontal louver blinds that cannot be repaired in a manner approved by Architect before time of Substantial Completion.

END OF SECTION 122113

SECTION 220010 – GENERAL REQUIREMENTS (PLUMBING)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 22.

1.2 RELATED REQUIREMENTS

- A. Section 01 74 19 “Construction Waste Management and Disposal.”

1.3 SUMMARY

- A. This Section includes general administrative and procedural requirements for plumbing system installations. It is intended to supplement Division 1 sections. Any conflicts shall be brought to the attention of the Architect/Engineer for clarification.
- B. Contractor shall also include the following specification sections as part of Division 22 contract requirements:
 - 1. Section 23 00 10 – General Requirements
 - 2. Section 23 00 30 – Electrical Requirements for Equipment

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 WASTE MANAGEMENT

- A. Follow the procedures and practices for waste separation, collection, and transport as defined in the Waste Management Plan specified in Section 01 74 19 “Construction Waste Management and Disposal.”

END OF SECTION 220010

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Bronze ball valves.
- 2. Iron, single-flange butterfly valves.
- 3. Iron, grooved-end butterfly valves.
- 4. Bronze lift check valves.
- 5. Bronze swing check valves.
- 6. Iron swing check valves.
- 7. Iron, grooved-end swing check valves.
- 8. Iron, center-guided check valves.
- 9. Lubricated plug 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.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Non-rising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated.
- B. Grooved joint couplings and fitting shall be referred to on drawings and product submittals, and be identified by the manufacturer's listed model or series designation.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.
- D. Grooved end valves shall be of the same manufacturer as the adjoining couplings.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Lead Free silicon bronze (ASTM listed) valves shall be made with corrosion-resistant materials. Manufacturer shall provide third party certification tested in accordance with EN ISO 6509 regarding dezincification corrosion resistance and stress corrosion cracking.

- C. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- D. Valve Sizes: Same as upstream piping unless otherwise indicated.
- E. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 (DN 200) and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 and smaller.
 - 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug-valve head.
- F. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:
 - 1. Ball Valves: With extended operating handle of non-thermal-conductive material that meets UL 2043 approved for inside air plenum, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied. Butterfly Valves: With extended neck.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO NIB-SEAL (-NS suffix in figure no.), handle extension or approved equal.
- G. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Grooved: With grooves according to AWWA C606.
 - 3. Solder Joint: With sockets according to ASME B16.18.
 - 4. Threaded: With threads according to ASME B1.20.1.
 - 5. PEX-a: Use F1960 connection. Crimp and clamp are not allowed.
- H. Valve Bypass and Drain Connections: MSS SP-45.

2.2 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
 - 1. Hammond Valve.
 - 2. Milwaukee Valve Company.
 - 3. NIBCO INC.
 - 4. Stockham
 - 5. Victaulic Company

2.3 BRONZE BALL VALVES

- A. All valves shall be “no-lead” certified.
- B. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
 - 1. Description:
 - a. Standard: MSS SP-110.

- b. SWP Rating: 150 psig
- c. CWP Rating: 600 psig
- d. Body Design: Two piece.
- e. Body Material: Bronze (NSF 61 UL Compliant)
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full (no exceptions)

- 2. Acceptable Full Port Valves: Lead-free NIBCO Model T/PC-585-66-LF (-NS) with NIBCO Copper x Male adapters; figure no. 604 or PC604 Press x Male adapters. or the Victaulic Style No. 721 and 726 with grooved ends; and Series P589 with Vic-Press ends.

2.4 IRON, LUG BODY OR GROOVED BODY BUTTERFLY VALVES

A. 300 CWP, Ductile Iron, Lug Body Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

- 1. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Grooved or lug type; suitable for bidirectional dead-end service at rated pressure. Body to have 2" extended neck for insulating.
 - d. Body Material: ASTM A 536, ductile iron.
 - e. Seat: EPDM (field replaceable and rated for 250 F), pressure-responsive.
 - 1) Seat shall be UL classified in accordance with ANSI / NSF-61 for potable water service.
 - f. Stem: two-piece stainless steel.
 - 1) Stem shall be offset from the disc centerline to provide complete 360-degree circumferential seating.
 - g. Disc: Aluminum bronze or stainless steel.
 - h. Sizes 2-1/2" to 6" shall be lever operated with ten position throttling plate. Sizes 8" and larger to have weatherproof gear operator.
- 2. Acceptable Butterfly Valves: Milwaukee Valve ML Series, Stockham LD712-B-S3-E or LG712BS3-E-M, NIBCO Model LD-2000N-3/5 or the Victaulic Style No. Vic300 MasterSeal.

B. 300 CWP, Cast Bronze Body with Copper-Tube Dimensioned Grooved Ends.

- 1. Description:
 - a. CWP Rating: 300 psig CWP.
 - b. Body Design: Grooved ends, copper-tubing sized.
 - c. Body Material: ASTM B 584, cast bronze.
 - d. Disc Coating: EPDM.
 - 1) Coating shall be UL classified in accordance with ANSI / NSF-61 for potable water service.
 - e. Stem: Integrally cast with disc.

- f. Sizes: 2-1/2" through 6", lever handle or gear operated as required.
- 2. Acceptable Manufacturer: Victaulic Series 608 or NIBCO Model GD-4765N-3/5.

2.5 BRONZE LIFT CHECK VALVES

- A. Class 125, Lift Check Valves with Bronze Disc:
 - 1. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze. (NSF 61 Compliant)
 - e. Ends: Threaded.
 - f. Disc: Bronze (metal) Buna-N NBR, PTFE, or TFE. (non-metal)
 - 2. Acceptable Valves: Milwaukee Valve 548T or 1548T, NIBCO Model T-480-Y-LF with NIBCO Copper x Male adapters; figure no. 604

2.6 BRONZE SWING CHECK VALVES

- A. Class 125, Bronze Swing Check Valves
 - 1. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig
 - c. Body Design: T pattern
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded or soldered.
 - f. Disc: Bronze (metal) Disc: NBR, PTFE, or TFE. (non-metal)
 - 2. Acceptable Valves: Milwaukee Valve 509 or 1509, NIBCO Model T-413-Y-LF with NIBCO Copper x Male adapters; figure no. 604, Stockham B-316Y

2.7 IRON SWING CHECK VALVES

- A. Class 125, Iron Swing Check Valves
 - 1. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.
 - 2. Acceptable Valves: Milwaukee Valve F2974M, NIBCO Model F938-33, Stockham G931
- B. Class 250, Iron Swing Check Valves with Metal Seats:

1. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 500 psig
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.
2. Acceptable Valves: Milwaukee Valve 2970, Nibco F-968, Stockham F947

2.8 DUCTILE IRON, GROOVED-END SWING CHECK VALVES

A. 300 CWP, Iron, Grooved-End Swing Check Valves:

1. Description:
 - a. CWP Rating: 300 psig
 - b. Body Material: ASTM A 536, ductile iron.
 - c. Seal: EPDM.
 - d. Disc: Spring-operated, ductile iron or stainless steel.
 - e. Suitable for vertical or horizontal installation.
2. Acceptable Valves: Victaulic Company Series 716.

2.9 IRON, CENTER-GUIDED CHECK VALVES

A. Class 125, Iron, Globe, Center-Guided Check Valves with Metal Seat:

1. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 200 psig
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: Bronze.
2. Acceptable Valves: Milwaukee Valve 1800 Series, NIBCO Model F/W-910-B-LF

B. Class 250, Iron, Globe, Center-Guided Check Valves with Metal Seat:

1. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 400 psig
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: Bronze.

2. Acceptable Valves: Milwaukee Valve 1850

2.10 IRON OS&Y GATE VALVES

A. Class 125, OS&Y, Iron Gate Valves:

1. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. CWP Rating: 200 psig
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Disc: Solid wedge.
 - g. Packing and Gasket: Asbestos free.
2. Acceptable Valves: Milwaukee Valve F-2885A, Nibco F-639-33, Stockham G-623

B. Class 250, OS&Y, Iron Gate Valves:

1. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. CWP Rating: 500 psig
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Disc: Solid wedge.
 - g. Packing and Gasket: Asbestos free.
2. Acceptable Valves: Milwaukee Valve F-2894A, Stockham G-667

2.11 LUBRICATED PLUG VALVES

A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends or Flanged Ends

1. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 200 psig
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular
 - e. Plug: Cast iron or bronze with sealant groove.
2. Acceptable Valves: Flowserve Nordstrom 142 or 143

2.12 BALANCING VALVES

A. Adjustable Thermal Balancing Valve for domestic hot water recirculation circuits.

1. Manufacturers:
 - a. Caleffi
 - b. ThermOmegaTech Circuit Solver

2. Internal thermostatic balancing cartridge automatically modulates flow to ensure constant temperature which is adjustable from 95 degrees F to 140 degrees F. Sizes ½” and ¾” with NPT female connections. Provide with DZR low-lead brass valve, stainless steel and copper adjustable thermostatic cartridge, EPDM hydraulic seals, 302 stainless steel springs, ABS adjustment knob with temperature adjustment scale and tamper-proof adjustment locking screw, and 10 mm temperature gauge/probe dry-well port. Provide with optional check valve and pre-formed insulation shell. Provide with optional outlet temperature gauge, 30 degrees F to 180 degrees F scale, 1½ inch diameter.
 - a. Maximum working pressure: 230 psi (16 bar).
 - b. Maximum differential pressure: 15 psi (1 bar).
 - c. Maximum inlet temperature: 195 degrees F (90 degrees C).
 - d. Flow rating: 2.1 Cv (1.8 Kv) maximum, 0.23 Cv (0.2 Kv) minimum, 0.52 Cv (0.45 Kv) design.
 - e. Suitable fluid: water.
 - f. Meets requirements of ANSI/NSF 372-2011. Certified to low-lead laws and listed by ICC-ES, file PMG-1360, for use in accordance with U.S. and Canadian plumbing codes.

3. Caleffi Model:
 - a. Code series 1162, for domestic hot water recirculation circuits with thermostatic by-pass cartridge for thermal disinfection function. Complete with outlet temperature gauge. Disinfection temperature 160 degrees F (70 degrees C), closing temperature 170 degrees F (75 degrees C) and disinfection flow rating 1.2 Cv (1.0 Kv).

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.
- F. Grooved ends shall be clean and free from indentations and projections in the area from valve end to groove.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball or butterfly valves. OS&Y where indicated on the plans.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) or grooved type.
 - 3. Throttling Service: thermostatic balancing cartridge
 - 4. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves.
 - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided.
 - c. Center Lift Check Valves with Bronze Disc.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends or soldered
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Grooved or Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 and Larger: Grooved Flanged ends.
 - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends
 - 6. For Steel Piping, NPS 5 and Larger: Flanged ends.
 - 7. For Grooved-End: Valve ends may be grooved.

3.5 GAS VALVES

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: threaded ends.
2. Ball Valves: two piece, full port, bronze with bronze trim.

B. Pipe NPS 2-1/2 and larger

1. Plug valves

3.6 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, bronze with bronze trim.
3. Bronze Swing Check Valves: Class 125 bronze or nonmetallic disc.
4. Balancing: thermostatic balancing cartridge

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: Grooved or flanged ends.
2. Iron Ball Valves: Class 150.
3. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze disc.
4. Iron, Grooved-End Butterfly Valves: 175 CWP.
5. Iron Swing Check Valves: Class 125 metal seats.
6. Iron, Grooved-End Swing Check Valves: 300 CWP.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following hangers and supports for plumbing system piping and equipment:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Pipe stands.
 - 7. Equipment supports.
- B. Related Sections include the following:
 - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment.

1.5 SUBMITTALS

- A. Product Data: For the following:

1. Steel pipe hangers and supports.
 2. Powder-actuated fastener systems.
 3. Pipe positioning systems.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
1. Trapeze pipe hangers. Include Product Data for components.
 2. Metal framing systems. Include Product Data for components.
 3. Pipe stands. Include Product Data for components.
 4. Equipment supports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
1. National Pipe Hanger Corporation.
 2. AAA Technology & Specialties Co., Inc.
 3. Bergen-Power Pipe Supports.
 4. B-Line Systems, Inc.; a division of Cooper Industries.
 5. Carpenter & Paterson, Inc.
 6. Empire Industries, Inc.
 7. ERICO/Michigan Hanger Co.
 8. Globe Pipe Hanger Products, Inc.
 9. Grinnell Corp.
 10. GS Metals Corp.
 11. MIRO Industries
 12. PHD Manufacturing, Inc.
 13. PHS Industries, Inc.
 14. Pipe Shields, Inc.
 15. Rilco Manufacturing Company, Inc.
 16. Piping Technology & Products, Inc.
 17. Tolco Inc.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Galvanized, Metallic Coatings: Pre-galvanized or hot dipped. All metal to be galvanized.
- C. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Coatings: Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

2.5 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.
 - 1. Manufacturers:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
 - c. Masterset Fastening Systems, Inc.
 - d. MKT Fastening, LLC.
 - e. Powers Fasteners.
- B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Powers Fasteners.

2.6 PIPE STAND FABRICATION

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Low-Type, Single-Pipe Stand: One-piece UV resistant polycarbonate resin base unit with integral slot for pipe, for roof installation without membrane penetration.
 - 1. MIRO Industries: Model 1.5
- C. Low-Type, Single-Pipe Stand: One-piece UV resistant polycarbonate resin base unit with plastic roller, for roof installation without membrane penetration.
 - 1. MIRO Industries: Model 4-RAH

2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT PROJECT SPECIFIC REQUIREMENTS

- A. Refer to individual piping specifications for specific requirements of the type of hangers and supports to utilize.

3.2 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Galvanized Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
 - 3. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 4. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 5. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36 (DN 100 to DN 900), with steel pipe base stanchion support and cast-iron floor flange.
 - 6. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36 (DN 100 to DN 900), with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
 - 7. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36 (DN 65 to DN 900), if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
 - 8. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30 (DN 25 to DN 750), from 2 rods if longitudinal movement caused by expansion and contraction might occur.

9. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20 (DN 65 to DN 500), from single rod if horizontal movement caused by expansion and contraction might occur.
 10. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42 (DN 50 to DN 1050), if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 11. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24 (DN 50 to DN 600), if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 12. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30 (DN 50 to DN 750), if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- F. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500).
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500), if longer ends are required for riser clamps.
- G. 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 (150 mm) for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.
- H. 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 (340 kg).
 - b. Medium (MSS Type 32): 1500 lb (680 kg).
 - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- I. 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.
- J. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- K. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- L. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- M. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.3 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) 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.
- F. Pipe Stand Installation:
1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.
- G. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.
- H. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. 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.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- M. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- O. Insulated Piping: Comply with the following:
1. Attaching clamps and spacers to piping and insulation.
 - 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. Maintain continuous insulation and vapor barrier.
 - c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) 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 (DN 100) 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 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
 - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
5. Pipes NPS 8 (DN 200) and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.4 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.5 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.6 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.

3.7 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Contract Drawings and the Standard Form of Agreement apply to this Section.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes plumbing system identification materials and devices.

1.3 SUBMITTALS

- A. Product Data: For identification materials and devices.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Comply with ASME A13.1, "Scheme for the Identification of Piping Systems" for lettering size, length of color field, colors, and viewing angles of identification devices.

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.

PART 2 - PRODUCTS

2.1 IDENTIFYING DEVICES AND LABELS

- A. General: Products specified are for applications referenced in other Division 23 Sections. If more than a single type is specified for listed applications, selection is Installer's option. Subject to compliance with requirements, manufacturers offering mechanical identification materials which may be incorporated in the work include but not limited to, the following:
1. Seton Name Plate Co.
 2. National Marker Co.
 3. Marking Services, Inc.
- B. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.
1. Data: Manufacturer, product name, model number, serial number, capacity, operating, and power characteristics, labels of tested compliances, and essential data.
 2. Location: Accessible and visible.
- C. Snap-On Plastic Pipe Markers: Manufacturers standard preprinted, semi-rigid, snap-on type. Include color-coding according to ASME A13.1, unless otherwise indicated.
1. Acceptable Product: Seton Identification Products "Set Mark".
- D. Pressure-Sensitive Pipe Markers: Manufacturers standard preprinted, color coded, pressure-sensitive, vinyl type with permanent adhesive.
1. Acceptable Product: Seton Identification Products "Opti-Code".
- E. Pipes with OD, Including Insulation, Less than 6 inches: Full-band pipe markers, extending 360 degrees around pipe at each location.
- F. Pipes with OD, Including Insulation, 6 inches and larger: Either full-band or strip-type pipe markers, at least 3 times letter height and of length required for label.
- G. Lettering: Manufacturer's standard preprinted captions as selected by Engineer.
1. 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.
- H. Plastic Tape: Manufacturer's standard color-coded, pressure sensitive, self-adhesive, vinyl tape, at least 3 mils thick.
1. Width: 1-1/2 inches on pipes with OD, including insulation, less than 6 inches; 2-1/2 inches for larger pipes.
 2. Color: Comply with ASME A13.1, unless otherwise indicated
 3. Acceptable Product: Seton Identification Products "Marking Tape".
- I. Valve Tags: Engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch sequenced numbers. Include 5/32-inch hole for fastener.
1. Material: 3/32-inch- thick plastic laminate with 2 black surfaces and a white inner layer.
 2. Size: 1-1/2-inches diameter, unless otherwise indicated.

3. Acceptable Product: Seton Identification Products “Style No. 31496”.
- J. Valve Tag Fasteners: Plastic cable tie.
- K. Access Panel Markers: 1/16-inch- thick, engraved plastic-laminate markers, with abbreviated terms, and numbers corresponding to concealed valve. Provide pressure-sensitive permanent adhesive backing.
1. Acceptable Product: Seton Identification Products “Opti-Code”
- L. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine sub-core, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
1. Engraving: Engraver’s standard letter style, of sizes and with terms to match equipment identification.
 2. Thickness: 1/16 inch, for units up to 20 sq. in or 8 inches in length, and 1/8 inch for larger units.
 3. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.
 4. Acceptable Product: Seton Identification Products “Engraved DataName Plates”
- M. Plastic Equipment Markers: Manufacturer’s standard laminated plastic, in the following color codes:
1. Green: Cooling equipment and components.
 2. Yellow: Heating equipment and components.
 3. Brown: Energy reclamation equipment and components.
 4. Blue: Equipment and components that do not meet criteria above.
 5. Hazardous Equipment: use colors and designs recommended by ASME A 13.1.
 6. Terminology: Match schedules as closely as possible. Include the following:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
 7. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.
- N. Plasticized Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with mat finish suitable for writing.
1. Size: 3 by 5-3/4 inches.
 2. Fasteners: Brass grommets and wire.
 3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
 4. Acceptable Product: Seton Identification Products “Style No. M3361”.
- O. 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: Identify individual system number and service if multiple systems of same name are indicated.

PART 3 - EXECUTION

3.1 LABELING AND IDENTIFYING PIPING SYSTEMS

- A. Install pipe markers on each system. Include arrows showing normal direction of flow.
- B. Marker Type: Plastic markers, with application systems. Install on pipe insulation segment where required for hot, non-insulated pipes.
- C. Fasten markers on pipes and insulated pipes smaller than 6 inches OD by one of the 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 a minimum of 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
- D. Fasten markers on pipes and insulated pipes 6 inches in diameter and larger 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 a minimum of 3 inches 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 or plastic cable ties.
- E. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior non-concealed locations according to the following:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.
 - 3. Near penetrations through walls, floors, ceilings, or non-accessible 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. Spaces at a maximum of 50-foot intervals along each run. Reduce intervals to 25 feet in area of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

3.2 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; and terminal devices and similar roughing-in connections of end-use terminal units.
- B. Tag Material: Plastic

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3.3 ADJUSTING AND CLEANING

- A. Relocate identification materials and devices that have become visually blocked by work of this or other Divisions.

END OF SECTION 220553

SECTION 220700 - PLUMBING 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 RELATED REQUIREMENTS

- A. Section 01 74 19 "Construction Waste Management and Disposal."

1.3 SUMMARY

- A. Section Includes:

- 1. Insulation Materials:
 - a. Flexible elastomeric.
 - b. Mineral fiber.
- 2. Insulating cements.
- 3. Adhesives.
- 4. Mastics and Sealants.
- 5. Factory-applied jackets.
- 6. Field-applied jackets.
- 7. Tapes.

- B. Related Sections include the following:

- 1. Division 01 Section "Sustainable Design Requirements" for additional LEED requirements.

1.4 DEFINITIONS

- 1. ASJ: All Service Jacket
- 2. FSK: Foil Scrim Kraft

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, 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 attachment and covering of heat tracing inside insulation.

3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

1.6 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: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.7 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.

1.8 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.9 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- 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 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. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. Flexible Elastomeric: Closed-cell foam or expanded rubber tubular materials with both a moisture seal and a reinforced elastic foam PSA lap seal closure system complying with ASTM C 534, type 1, Grade 1.
 - 1. Products: Subject compliance with requirements, provide from the following or approved equal.
 - a. Armacell LLC
 - b. K-Flex USA
 - c. Or approved equal
 - 2. Acceptable Product: Armacell LLC Model "Lap Seal".
- 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 Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ Jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

2.6 SEALANTS

- A. FSK and 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.
 - 5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. ASJ Flashing Sealants, and Vinyl, PVDC, 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.
 - 5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 - 1. Products: Subject to compliance with requirements provide one of the following.
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.
 - d. Or approved equal
 - 2. Adhesive: As recommended by jacket material manufacturer.
 - 3. Color: White
 - 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
 - 5. Factory-fabricated tank heads and tank side panels.

2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

PART 3 - EXECUTION

3.1 WASTE MANAGEMENT

- A. Follow the procedures and practices for waste separation, collection, and transport as defined in the Waste Management Plan specified in Section 01 74 19 "Construction Waste Management and Disposal."

3.2 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.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.4 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment 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 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. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 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 pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.5 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 Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Division 07 Section "Penetration Firestopping" and fire-resistive joint sealers.
- D. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.6 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, 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.

3.7 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.

3.8 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.

3.9 FINISHES

A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.10 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. 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 two location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
2. 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 pipe/fitting of each type.

B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Underground piping.
2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water, Domestic Hot and Recirculated Hot 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: 1.5 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1.5 inch thick.

B. Storm water and Overflow, Roof Drain and Overflow Drain Bodies:

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.

C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be pre-formed as manufactured.
2. Or approved equal.

END OF SECTION 220700

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 RELATED REQUIREMENTS

- A. Section 017419 "Construction Waste Management and Disposal."

1.3 SUMMARY

- A. Section Includes:
 - 1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
 - 2. Specialty valves.
 - 3. Flexible connectors.

1.4 SUBMITTALS

- A. Product Data: For the following products:
 - 1. Dielectric fittings.
 - 2. Water meters.
 - 3. Grooved joint couplings and fittings.
- B. Water Samples: Specified in "Cleaning" Article.
- C. Field quality-control reports.
- D. Identify each regionally extracted and manufactured material, including its source and cost

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61 for potable domestic water piping and components.
- C. All grooved couplings, and fittings, valves and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

1. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
 1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
 5. Grooved End Fittings: Wrought copper ASME B16.22 or cast bronze ASME B16.18, manufactured to copper-tubing sizes. (Flaring of tube or fitting ends to accommodate alternate sized couplings is not permitted.) Basis of Design: Victaulic Copper-Connection.
 6. Grooved-Joint Couplings for Copper-Tubing: Copper-tube dimensions. Include ferrous housing sections cast with offsetting, angle-pattern, bolt pads, EPDM-HP rubber gaskets suitable for hot and cold water, and ASTM A449 electroplated steel bolts and nuts. Installation-Ready, for direct stab installation without field disassembly. Basis of Design: Victaulic Style 607H or equal.
 - a. Gaskets shall be UL classified in accordance with ANSI / NSF-61 for potable water service.
- B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

2.3 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 1. Standard-Pattern, Mechanical-Joint Fittings: AWWA C110, ductile or gray iron.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 1. Standard-Pattern, Push-on-Joint Fittings: AWWA C110, ductile or gray iron.
 - a. Gaskets: AWWA C111, rubber.
- C. Plain-End, Ductile-Iron Pipe: AWWA C151.

1. Grooved-Joint, Ductile-Iron-Pipe Appurtenances:

- a. Manufacturers: Victaulic Company or equal
- b. Grooved-End, Ductile-Iron Fittings: ASTM A 536, ductile-iron castings with dimensions matching pipe. Basis of Design: Victaulic AWWA Fittings.
- c. Grooved-End, Ductile-Iron-Pipe Couplings: AWWA C606 for ductile-iron-pipe dimensions. Include ferrous housing sections, EPDM-FlushSeal elastomer gaskets suitable for hot and cold water, and ASTM A449 electroplated steel bolts and nuts. Basis of Design: Victaulic Style 31.
 - 1) Gaskets shall be UL classified in accordance with ANSI / NSF-61 for potable water service.

2.4 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- E. Grooved Joint Lubricants: Lubricate gaskets in accordance with the manufacturer's published installation instructions, using lubricant compatible with the gasket elastomer and fluid media. Basis of Design: Victaulic Vic-Lube.

2.5 SPECIALTY VALVES

- A. Comply with requirements in Division 23 Section "General-Duty Valves" for general-duty metal valves.
- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for rain valves, backflow preventers, and vacuum breakers.

2.6 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.

2.7 FLEXIBLE CONNECTORS

- A. 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 (DN 50) and Smaller: Threaded steel-pipe nipple.

PART 3 - EXECUTION

3.1 WASTE MANAGEMENT

- A. Follow the procedures and practices for waste separation, collection, and transport as defined in the Waste Management Plan specified in Section 01 74 19 "Construction Waste Management and Disposal."

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook." Insulate with 1" thick closed cell foam, lay in a 6" bed of sand and cover with 6" of sand.
- C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 23 Section "Meters and Gages" for pressure gages and Division 22 Section "Plumbing Specialties" for drain valves and strainers.
- D. Install shutoff valve immediately upstream of each dielectric fitting.
- E. Install domestic water piping with 0.25 percent slope downward toward drain and plumb.
- F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- G. 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.
- H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- I. Install piping adjacent to equipment and specialties to allow service and maintenance.
- J. Install piping to permit valve servicing.
- K. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- L. Install piping free of sags and bends.
- M. Install fittings for changes in direction and branch connections.
- N. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

- O. Install thermometers on outlet piping from each water heater. Comply with requirements in Division 23 Section "Meters and Gages" for thermometers.

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. 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. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Ductile-Iron-Piping Grooved Joints: Cut groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join ductile-iron pipe and grooved-end fittings according to AWWA C606 for ductile-iron-pipe, cut-grooved joints. A factory-trained field representative (direct employee) of the mechanical joint manufacture shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. The factory-trained representative shall periodically review the product installation and ensure best practices are being followed. Contractor shall remove and replace any improperly installed products.

3.4 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures. Use ball for piping NPS 2 (DN 50) and smaller. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

3.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 23 Section "Hangers and Supports for Piping and Equipment" for pipe hanger and support products and installation.
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
- E. Install supports for vertical copper tubing every 10 feet.
- F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping.
- D. Extend and connect domestic water piping 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 required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
 - 3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection.

3.8 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.

- B. Install cast-iron sleeve at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight.

3.9 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 23 Section 220553 for identification materials and installation.
- B. Label pressure piping with system operating pressure.

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- C. Piping Tests:
 - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - 3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 4. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 - 6. Prepare reports for tests and for corrective action required.
- D. Domestic water piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.11 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. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 4. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 5. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.12 CLEANING

- A. Cleaning and flushing of new piping shall be done by phase. Do not connect new pipe to active piping systems until all flushing and cleaning has been done. Provide temporary pipe connection and flushing pump.
- B. Clean and disinfect potable and 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 (50 mg/L) 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 (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.13 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Above slab domestic water and and fire-service-main piping NPS 3 to NPS 8 shall be one of the following:
1. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.

- D. Under-building-slab, domestic water, building-service piping, and and fire-service-main piping NPS 3 to NPS 8 shall be one of the following:
 - 1. Mechanical-joint, ductile-iron pipe; standard pattern mechanical-joint fittings; and mechanical joints. Provide restraints.
 - 2. Push-on-joint, ductile-iron pipe; standard pattern push-on-joint fittings; and gasketed joints. Provide restraints.
- E. Under-building-slab, domestic water piping shall be the following:
 - 1. Soft copper tube, ASTM B 88, Type K; wrought-copper solder-joint fittings; and brazed joints.
- F. Aboveground domestic water piping, NPS 2 and smaller shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L with wrought copper solder-joint fittings; and soldered joints.

3.14 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use ball for piping NPS 2 and smaller. Do not use gate valves.
 - 2. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

SECTION 221118 – PEX 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 USE OF PEX

- A. PEX tubing may be used for all piping within the domestic water system that is sized 3" and below. All other water piping shall be as specified in specification section 22 11 16.
- B. Connections to the domestic water generator shall be copper. Transition to PEX five feet beyond connections.
- C. All exposed piping under sinks shall be chrome plated brass. No PEX shall be used exposed under sinks.
- D. Penetrations of PEX through fire rated assemblies shall be properly sealed and meet the UL listing for the assembly.
- E. All connections shall be made using full diameter F1960 fittings. Clamp or crimp fittings are not allowed.

1.3 SUMMARY

- A. Section Includes:
 - 1. PEX aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
 - 2. Specialty valves.
- B. Related Section:
 - 1. Division 22 Section 22 11 16 Domestic Water Piping
 - 2. Division 2 Section for water-service piping outside the building from source to the point where water-service piping enters the building.

1.4 WATER SERVICE REQUIREMENTS

- A. Refer to Division 22 Section 22 11 16 Domestic Water Piping

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's product submittal data and installation instructions.

1. Tubing and fittings
 2. Hanger spacing
 3. Dielectric fittings.
- B. Shop Drawings: Provide installation drawings indicating tubing layout, manifold locations (if indicated to be used on the construction drawings), plumbing fixtures supported and schedules with details required for installation of the system.
- C. Samples: Submit selection and verification samples of tubing.
- D. Quality Assurance/Control Submittals: Submit the following:
1. Test Reports: Upon request, submit test reports from recognized testing laboratories.
 2. Certificates: Submit the following:
 - a. Manufacturer's certificate that products comply with specified requirements.
 - b. Certificate indicating that the installer is authorized to install the manufacturer's products
- E. Closeout Submittals: Submit the following:
1. Warranty documents specified herein
 2. Operation and maintenance data
- 1.6 QUALITY ASSURANCE
- A. Installer Qualifications: Use an installer with demonstrated experience on projects of similar size and complexity and possessing documentation proving successful completion of PEX plumbing installation training by the PEX tubing manufacturer.
- B. Regulatory Requirements and Approvals: Provide domestic potable system that complies with requirements of the following:
1. International Code Conference (ICC) – International Plumbing Code (IPC). ICC Evaluation Service (ES) Evaluation Report No. ESR 1099
 2. National Standard Plumbing Code (NSPC)
 3. HUD Material Release No. 1269
- C. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- D. Comply with NSF 61 for potable domestic water piping and components.
- E. Certifications: Provide letters of certification as follows:
1. Installer is trained by the PEX tubing manufacturer to install the PEX potable water distribution system.
 2. Installer will use skilled workers holding a trade qualification license or equivalent, or apprentices under the supervision of a licensed trades professional.
- 1.7 DELIVERY, STORAGE AND HANDLING
- A. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
 - 1. Store PEX tubing in cartons or under cover to avoid dirt or foreign material from being introduced into the tubing.
 - 2. Do not expose PEX tubing to direct sunlight for more than 30 days. If construction delays are encountered, provide cover to portions of tubing exposed to direct sunlight.

PART 2 - PRODUCTS

2.1 BASIS OF DESIGN - Hot and Cold Potable Water Distribution Tubing

- A. The basis of design is a PEX-a tubing system that has fittings with the same internal diameter as the tubing. Fittings that have a smaller internal diameter shall not be used.
- B. Manufacturer:
 - 1. Uponor: Contact: 5925 148th Street West, Apple Valley, MN 55124; Toll free (800) 321-4739, (952) 891-2000; Fax: (952) 891-2008; website: www.uponor-usa.com
 - 2. Rehau
 - 3. HeatLink

2.2 MATERIALS

- A. Tubing
 - 1. Material: Crosslinked polyethylene (PEX) manufactured by PEX-a or Engel method
 - 2. Type: Uponor/Wirsbo AQUAPEX
 - 3. Material Standard: Manufactured in accordance with ASTM F876 and ASTM F877 and tested for compliance by an independent third party agency
 - 4. Standard grade hydrostatic design and pressure ratings from PPI
 - 5. Fire-rated assembly listings in accordance with ANSI/UL 263
 - a. UL Design No. L557 — 1-hour wood frame floor/ceiling assemblies
 - b. UL Design No. K913 — 2-hour concrete floor/ceiling assemblies
 - c. UL Design No. U372 — 1-hour wood stud/gypsum wallboard wall assemblies
 - d. UL Design No. V444 — 1-hour steel stud/gypsum wallboard wall assemblies
 - 6. Minimum Bend Radius (cold bending): No less than six times the outside diameter. Use a bend support as supplied by the PEX tubing manufacturer for tubing with a bend radius less than stated.
 - 7. Nominal Inside Diameter: Provide tubing with nominal inside diameter, in accordance with ASTM F876 as indicated.
 - a. 3/8 inch [9.53mm]
 - b. 1/2 inch [12.7mm]
 - c. 3/4 inch [19.05mm]
 - d. 1 inch [25.4mm]
 - e. 1 1/4 inch [31.75mm]

- f. 1½ inch [38.1mm]
- g. 2 inch [50.8mm]
- h. 3 inch []

B. Fittings

- 1. Same internal diameter as the tubing.
- 2. Material: Fitting assembly is manufactured from material listed in paragraph 5.1 of ASTM F1960.
- 3. Material Standard: Comply with ASTM F1960.
- 4. Type: PEX-a cold expansion fitting.
 - a. Assembly consists of the appropriate ProPEX insert with a corresponding ProPEX Ring.

C. Manifolds

- 1. Manifolds shall not be used.

D. Accessories

- 1. Angle stops and straight stops that are compatible with PEX tubing may supplied by the PEX tubing manufacturer.
- 2. Bend supports designed for maintaining tight radius bends are supplied by the PEX tubing manufacturer.
- 3. ProPEX expander tool to install the ASTM F1960 compatible fittings shall be supplied by the PEX tubing manufacturer.
- 4. The tubing manufacturer shall provide clips and/or PEX rails for supporting tubing runs.
- 5. All horizontal tubing hangers and riser clamps shall be epoxy-coated material.

2.3 SYSTEM DESCRIPTION

A. Design Requirements

- 1. Standard grade hydrostatic pressure ratings from Plastics Pipe Institute (PPI) in accordance with TR-3 as listed in TR-4. The following three standard-grade hydrostatic ratings are required.
 - a. 200°F (93°C) at 80 psi (551 kPa)
 - b. 180°F (82°C) at 100 psi (689 kPa)
 - c. 73.4°F (23°C) at 160 psi (1,102 kPa)
- 2. Certification of flame spread/smoke development rating of 25/50 in accordance with ASTM E84 provided the installation meets one of the following requirements.
 - a. Tubing spacing is a minimum of 18 inches apart for the following sizes.
 - 1) ⅜ inch [9.53mm]
 - 2) ½ inch [12.7mm]
 - 3) ⅝ inch [15.88mm]
 - 4) ¾ inch [19.05mm]
 - b. Tubing is wrapped with ½” fiberglass insulation with a flame spread of not more than 20 and a smoke-developed rating of not more than 30 and a nominal density of 4.0 to 4.5 pcf. Tubing can run with three tubes separated by zero inches and then 18 inches between the next group of three tubes for the following sizes.

- 1) 3/8 inch [9.53mm]
- 2) 1/2 inch [12.7mm]
- 3) 5/8 inch [15.88mm]
- 4) 3/4 inch [19.05mm]
- 5) 1 inch [25.4mm]
- 6) 1 1/4 inch [31.75mm]
- 7) 1 1/2 inch [38.1mm]
- 8) 2 inch [50.8mm]

B. Performance Requirements: To provide a PEX tubing hot and cold potable water distribution system, which is manufactured, fabricated and installed to comply with regulatory agencies and to maintain performance criteria stated by the PEX tubing manufacturer without defects, damage or failure.

1. Comply with ANSI/NSF Standard 14.
2. Comply with ANSI/NSF Standard 61.
3. Show compliance with ASTM F877.
4. Show compliance with ASTM E119 and ANSI/UL 263 through certification listings with Underwriters Laboratories, Inc. (UL).
 - a. UL Design No. L557 — 1 hour wood frame floor/ceiling assemblies
 - b. UL Design No. K913 — 2 hour concrete floor/ceiling assemblies
 - c. UL Design No. U372 — 1 hour wood stud/gypsum wallboard wall assemblies
 - d. UL Design No. V444 — 1 hour steel stud/gypsum wallboard wall assemblies

2.4 WARRANTY

A. Provide a limited warranty for 25 years for Uponor/Wirsbo AQUAPEX® tubing and Wirsbo hePEX™ tubing and ProPEX® Fittings when installed by an Uponor-trained contractor and certified plumbing professional.

2.5 EXPANSION JOINTS

A. Flexible pipe loops shall be provided to allow for pipe expansion in the hot water and hot water recirculation piping.

2.6 PLENUM CEILING SPACES

A. Where indicated on the drawings that a Plenum-rated Piping System is needed or where installed exposed, the pipe shall be field insulated, and when tested with standard un-insulated fittings per CAN/ULC-S102.2-03 or ASTM E84, the system consisting of wrapped or coated pipe and bare fittings shall have a Flame Spread Classification of less than 25 and Smoke Development rating of less than 50.

2.7 VALVES

- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for drain valves, backflow preventers, and vacuum breakers.

2.8 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.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- C. Install shutoff valve immediately upstream of each dielectric fitting.
- D. Install domestic water piping with 0.25 percent slope downward toward drain and plumb.
- E. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- F. 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.
- G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- H. Install piping adjacent to equipment and specialties to allow service and maintenance.
- I. Install piping to permit valve servicing.
- J. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- K. Install piping free of sags and bends.
- L. Install fittings for changes in direction and branch connections.
- M. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- N. Install thermometers on outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

- O. Comply with manufacturer's product data, including product technical bulletins, installation instructions, design drawings and the Uponor Professional Plumbing Installation Guide.
- P. Verify that site conditions are acceptable for installation of the PEX potable water system. Do not proceed with installation of the PEX potable water system until unacceptable conditions are corrected.

3.2 PEX TUBING INSTALLATION

- A. Install PEX tubing in accordance with the tubing manufacturer's recommendations and as indicated in the installation handbook.
- B. Do not install PEX tubing within 6 inches [152 mm] of gas appliance vents or within 12 inches [305 mm] of any recessed light fixtures.
- C. Do not solder within 18 inches [457 mm] of PEX tubing in the same waterline. Make sweat connections prior to making PEX connections.
- D. Do not expose PEX tubing to direct sunlight for more than 30 days.
- E. Ensure no glues, solvents, sealants or chemicals come in contact with the tubing without prior permission from the tubing manufacturer.
- F. Use grommets or sleeves at the penetration for PEX tubing passing through metal studs.
- G. Protect PEX tubing with sleeves where abrasion may occur.
- H. Use strike protectors where PEX tubing penetrates a stud or joist and has the potential for being struck with a screw or nail.
- I. Use tubing manufacturer-supplied bend supports where bends are less than six times the outside tubing diameter.
- J. Minimum horizontal supports are installed not less than 32 inches between hangers in accordance with model plumbing codes and the installation handbook.
- K. PEX riser installations require epoxy-coated riser clamps installed at the base of the ceiling per floor.
- L. A mid-story support is required for riser applications.
- M. Pressurize PEX tubing with air in accordance with applicable codes or in the absence of applicable codes to a pressure of 25 psi (173 kPa) above normal working pressure of the system.
- N. Comply with safety precautions when pressure testing, including use of compressed air, where applicable. Do not use water to pressurize the system if ambient air temperature has the possibility of dropping below 32°F (0°C).
- O. Ensure compliance of one- and two-hour rated through penetration assemblies in accordance with ASTM E814.

3.3 FIELD QUALITY CONTROL

- A. Perform pressure testing for all tubing.

- A. Manufacturer's Field Services: Provide manufacturer's field service consisting of product use recommendations and one visit for inspection of product installation in accordance with manufacturer's instructions.

3.4 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures. Use ball for piping NPS 2 (DN 50) and smaller. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation. Follow PEX manufacturer's recommendations for support spacing.
- B. Support vertical piping and tubing at base and at each floor.
- C. Install hangers for PEX tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1" and Smaller: 32 inches with 3/8-inch rod.
 - 2. NPS 1-1/4 to 3" 48 inches with 3/8-inch rod.

Note: Hanger spacing can be increased to 8 ft when using Uponor "U" shaped metallic support channel.

- D. Install supports for vertical PEX tubing every 10 feet.
- E. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.6 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.

3.7 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 23 Section 220553 for identification materials and installation.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

B. Piping Inspections:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 CLEANING

- A. Cleaning and flushing of new piping shall be done by phase. Do not connect new pipe to active piping systems until all flushing and cleaning has been done. Provide temporary pipe connection and flushing pump.
- B. Clean and disinfect potable and 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 (50 mg/L) 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 (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
- c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.10 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Under-building-slab, domestic water, building service piping, NPS 2 and smaller shall be one of the following:
 1. Type K Copper
- C. Under-building-slab, domestic water piping shall be the following:
 1. Cross-linked polyethylene (PEX-a) tubing with 1" thick closed cell foam insulation
- D. Aboveground domestic water piping, NPS 2 and smaller shall be:
 1. Cross-linked polyethylene (PEX-a) tubing

3.11 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 1. Shutoff Duty: Use ball for piping NPS 2 and smaller. Do not use gate valves.
 2. Drain Duty: Hose-end drain valves.

END OF SECTION 221118

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 RELATED REQUIREMENTS

- A. Section 017419 "Construction Waste Management and Disposal."

1.3 SUMMARY

- A. This Section includes the following for soil, waste, and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.
- B. Related Sections include the following:
 - 1. Division 22 Section "Sanitary Sewerage Pumps."

1.4 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. LLDPE: Linear, low-density polyethylene plastic.
- D. NBR: Acrylonitrile-butadiene rubber.
- E. PE: Polyethylene plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. TPE: Thermoplastic elastomer.

1.5 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

1.6 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, hangers, and couplings.
- B. Shop Drawings:
 - 1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.
- C. Field quality-control inspection and test reports.

1.7 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.
- C. All cast iron pipe and fittings shall be marked with collective trademark of the cast iron soil pipe institute.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service Weight class.
- B. Gaskets: ASTM C 564, rubber and the ASTM C1563.
- C. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

Manufacturers:

- 1. Charlotte Pipe and Foundry
- 2. AB&I Foundry
- 3. Tyler Pipe; Soil Pipe Div.
- 4. Or approved equal.

2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - 1. Standard, Shielded, Stainless-Steel Couplings: : ASTM C 1277 and the CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
 - 2. Heavy-Duty, ASTM C1540 Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
 - a. Manufacturers that may be used provided they meet the specification are:
 - 1) ANACO
 - 2) Husky
 - 3) Clamp-All
 - 4) Charlotte Pipe and Foundry
 - 5) Mission Rubber Co.
 - 6) Tyler Pipe.
 - 7) Or approved equal.
- C. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

2.5 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
 - 1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.
- B. Solvent Cement and Adhesive Primer:
 - 1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 SPECIAL PIPE FITTINGS

- A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Sleeve Materials:
 - a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

- B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
- C. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.
- D. Pressure Pipe Couplings: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
 - 1. Center-Sleeve Material: Manufacturer's standard
 - 2. Gasket Material: Natural or synthetic rubber.
 - 3. Metal Component Finish: Corrosion-resistant coating or material.

PART 3 - EXECUTION

3.1 WASTE MANAGEMENT

- A. Follow the procedures and practices for waste separation, collection, and transport as defined in the Waste Management Plan specified in Section 01 74 19 "Construction Waste Management and Disposal."

3.2 EXCAVATION

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.3 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground, vent, soil and waste piping (in return air plenums or exposed use) 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 solvent stack fittings couplings; and hubless-coupling joints.
- C. Aboveground, vent, soil and waste piping 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 solvent stack fittings couplings; and hubless-coupling joints.
 - 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints. (except in return air plenums and where exposed)
 - 4. Dissimilar Pipe-Material Couplings: Flexible, Shielded, Rigid, unshielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- D. Underground, soil, waste, and vent piping shall be any of the following:
 - 1. Service class, cast-iron soil piping; with gasketed joints.

2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
3. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Flexible, Shielded, Rigid, unshielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

3.4 PIPING INSTALLATION

- A. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- B. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- C. Install underground, force-main piping. Install encasement on piping according to ASTM A 674 or AWWA C105.
- D. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside the building between wall and floor penetrations and connection to sanitary sewer piping outside the building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
 1. Install encasement on piping according to ASTM A 674 or AWWA C105.
- E. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
 1. Install encasement on piping according to ASTM A 674 or AWWA C105.
- F. Install underground, ductile-iron, special pipe fittings according to AWWA C600.
 1. Install encasement on piping according to ASTM A 674 or AWWA C105.
- G. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 23 Section "Basic Materials and Methods."
- H. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.
- I. 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.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- K. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install

required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

- L. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- M. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- N. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- O. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.5 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 23 Section "Basic Material and Methods."
- B. 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.
- C. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- E. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- F. Grooved Joints: Assemble joint with keyed coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- G. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Install individual, straight, horizontal piping runs according to the following:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.

- c. Longer than 100 Feet (30 m), if indicated: MSS Type 49, spring cushion rolls.
 3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 4. Base of Vertical Piping: MSS Type 52, spring hangers.
 - B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
 - C. Support vertical piping and tubing at base and at each floor.
 - D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
 - E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
 3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
 4. NPS 6 (DN 150): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
 5. NPS 8 to NPS 12 (DN 200 to DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
 - F. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).
 - G. Install hangers for PVC and PE piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 3. NPS 4 and 5 (DN 100 and 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 4. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 5. NPS 8 to NPS 12 (DN 200 to DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
 - H. Install supports for vertical PVC piping every 48 inches (1200 mm).
 - I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.
- 3.7 CONNECTIONS
- A. Drawings indicate general arrangement of piping, fittings, and specialties.
 - B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
 - C. Connect drainage and vent piping to the following:
 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.

4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.

D. Connect force-main piping to the following:

1. Sanitary Sewer: To exterior force main or sanitary manhole.
2. Sewage Pumps: To sewage pump discharge.

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.9 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PROTECTION

- A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION 221316

SECTION 221413 - FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 RELATED REQUIREMENTS

- A. Section 017419 “Construction Waste Management and Disposal.”

1.3 SUMMARY

- A. This Section includes the following storm drainage piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.

1.4 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. LLDPE: Linear, low-density polyethylene plastic.
- C. PVC: Polyvinyl chloride plastic.
- D. TPE: Thermoplastic elastomer.

1.5 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:
 - 1. Storm Drainage Piping: 10-foot head of water.

1.6 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Field quality-control inspection and test reports.

1.7 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.
- C. All cast iron pipe and fittings shall be marked with collective trademark of the cast iron soil pipe institute.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.
- B. Gaskets: ASTM C 564, rubber and the ASTM D 1563.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301. All cast iron pipe and fittings shall be marked with collective trademark of the cast iron soil pipe institute.
- B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - 1. Heavy-Duty, ASTM C 1540 Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
 - 2. Standard, Shielded, Stainless-Steel Couplings: ASTM C 1277 and CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
- C. All couplings for hubless cast iron soil pipe and fittings shall conform to CISPI 310 and be certified by NSF International.

2.4 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end, unless grooved or flanged ends are indicated.
 - 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end, unless grooved or flanged ends are indicated.
1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Gaskets: AWWA C111, rubber.

2.5 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent. (No Cellular Core Allowed)
- B. Solvent Cement and Adhesive Primer:
1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 WASTE MANAGEMENT

- A. Follow the procedures and practices for waste separation, collection, and transport as defined in the Waste Management Plan specified in Section 01 74 19 "Construction Waste Management and Disposal."

3.2 EXCAVATION

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.3 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground storm drainage piping shall be any one of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless cast-iron soil pipe and fittings; standard shielded, stainless-steel couplings; and coupled joints.
 3. Solid Core PVC pipe, PVC socket fittings, and solvent-cemented joints.
- C. Underground storm drainage piping shall be one of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless cast-iron soil pipe and fittings; standard shielded, stainless-steel couplings; and coupled joints.

3. Solid Core PVC pipe, PVC socket fittings, and solvent-cemented joints.

3.4 PIPING INSTALLATION

- A. Install cleanouts at grade and extend to where building storm drains connect to building storm sewer.
- B. Install underground, ductile-iron, special pipe fittings according to AWWA C600.
 1. Install encasement on piping according to ASTM A 674 or AWWA C105.
- C. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 23 Section "Basic Material and Methods".
- D. Install wall-penetration fitting system at each service pipe penetration through foundation wall. Make installation watertight.
- E. 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.
- F. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- G. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- H. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:
 1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
 2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.
- I. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- J. Install PVC storm drainage piping according to ASTM D 2665.
- K. Install underground PVC storm drainage piping according to ASTM D 2321.
- L. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.5 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 23 Section "Basic Material and Methods"

- B. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Hub-and-Spigot, Cast-Iron Soil Piping Calked Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- D. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- E. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
 - 3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
 - 4. NPS 6 (DN 150): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
 - 5. NPS 8 to NPS 12 (DN 200 to DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
 - 6. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).
- F. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).
- G. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 - 3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.

4. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
5. NPS 8 to NPS 12 (DN 200 to DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.

- H. Install supports for vertical PVC piping every 48 inches (1200 mm).
- I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.
 1. Storm Sewer: To exterior storm manhole.

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
 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 storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 5. Prepare reports for tests and required corrective action.

3.9 INSULATION

- A. All storm water piping above the slab to be insulated. Refer to specification section 220700.

3.10 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221413

SECTION 223000 - PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 RELATED REQUIREMENTS

- A. Section 017419 “Construction Waste Management and Disposal.”

1.3 SUMMARY

- A. This Section includes the following plumbing specialties:
 - 1. Backflow preventers.
 - 2. Thermostatic water mixing valves.
 - 3. Key-operation hydrants.
 - 4. Wheel-handle wall hydrants.
 - 5. Trap seal primer valves.
 - 6. Drain valves.
 - 7. Miscellaneous piping specialties.
 - 8. Sleeve penetration systems.
 - 9. P-traps and fixture valves.

1.4 DEFINITIONS

- A. The following are industry abbreviations for plastic piping materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. PE: Polyethylene plastic.
 - 3. PUR: Polyurethane plastic.
 - 4. PVC: Polyvinyl chloride plastic.

1.5 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Domestic Water Piping: 125 psig.
 - 2. Sanitary Waste and Vent Piping: 10-foot head of water.
 - 3. Storm Drainage Piping: 10-foot head of water.

1.6 SUBMITTALS

- A. Product Data: Include rated capacities and shipping, installed, and operating weights. Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections for the following:
 - 1. Backflow preventers and water regulators.
 - 2. Thermostatic water mixing valves and water tempering valves.
 - 3. Water hammer arresters, air vents, and trap seal primer valves and systems.
 - 4. Drain valves, hose bibbs, hydrants, and hose stations.
 - 5. Outlet boxes and washer-supply outlets.
 - 6. Cleanouts, floor drains, trench drains, and roof drains.
 - 7. Vent terminals, and roof flashing assemblies.
 - 8. Sleeve penetration systems.
- B. Field test reports.
- C. Maintenance Data: For plumbing specialties to include in maintenance manuals. Include the following:
 - 1. Hot water generator and tank.
 - 2. Backflow preventers and water regulators.
 - 3. Thermostatic water mixing valves and water tempering valves.
 - 4. Trap seal primer valves and systems.
 - 5. Hose stations and hydrants.

1.7 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of plumbing specialties and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- B. Plumbing specialties shall bear label, stamp, or other markings of specified testing agency.
- C. 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.
- D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for piping materials and installation.
- E. NSF Compliance:
 - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components. Include marking "NSF-pw" on plastic potable-water piping and "NSF-dwv" on plastic drain, waste, and vent piping.
 - 2. Comply with NSF 61, "Drinking Water System Components--Health Effects, Sections 1 through 9," for potable domestic water plumbing specialties.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Operating Key Handles: Equal to 100 percent of amount installed for each key-operated hose bibb and hydrant installed.

PART 2 - PRODUCTS

2.1 THERMOSTATIC WATER MIXING VALVES

- A. General: ASSE 1017, manually adjustable, thermostatic water mixing valve with bronze body. Include check stop and union on hot- and cold-water-supply inlets, adjustable temperature setting, and thermometer.
 - 1. Type: Liquid-filled motor, operation and pressure rating 100 psig minimum.
- B. Thermostatic Water Mixing Valves: Unit, with the following:
 - 1. Piping, valves, and unions.
 - 2. Thermometers
 - 3. Piping Component Finish: Rough bronze.
- C. Laboratory Mixing Valves: Thermostatic tempering valve shall be constructed of solid brass. The valve shall feature advance paraffin based actuation technology and union connections for ease of maintenance. All internal components shall be corrosion-resistant. Valve shall feature integral checks to prevent cross-flow and inlet screens to filter out debris. The valve shall be CSA B125 certified, ASSE 1016-96, ASSE 1069 and ASSE 1070 listed. Capacity of the valve shall be 12.0 gpm (45.0 lpm) at 45psi (310 kPa) differential. Valve shall perform to a minimum flow of 0.5 gpm (2 lpm) to ASSE 1016-96 and ASSE 1070. Control temperature shall be adjustable between 80°F - 120°F (27-49° C). The valve shall feature a vandal-resistant lockable handle to prevent tampering. The valve shall be a Powers' Hydroguard Model LM495 (1/2", 15mm), LM496 (3/4", 20mm), LM497 (1", 25mm) or equal.

2.2 STRAINERS

- A. Strainers: Y-pattern, unless otherwise indicated, and full size of connecting piping. Include ASTM A 666, Type 304, stainless-steel screens with 3/64-inch round perforations, unless otherwise indicated.
 - 1. Pressure Rating: 125-psig minimum steam working pressure, unless otherwise indicated.
 - 2. NPS 2 and Smaller: Bronze body, with female threaded ends.
 - 3. NPS 2-1/2 and Larger: Cast-iron body, with interior AWWA C550 or FDA-approved, epoxy coating and flanged ends.
 - 4. Y-Pattern Strainers: Screwed screen retainer with centered blowdown.
 - a. Drain: Factory hose-end drain valve.
 - 5. T-Pattern Strainers: Malleable-iron or ductile-iron body with grooved ends; access end cap with drain plug and access coupling with rubber gasket.
 - 6. Basket Strainers: Bolted flange or clamp cover, and basket with lift-out handle.
 - a. Type: Simplex with one basket.
 - b. Drain: Factory- or field-installed, hose-end drain valve.
- B. Drainage Basket Strainers: Non-pressure-rated, cast-iron or coated-steel body; with bolted flange or clamp cover and drain with plug.
 - 1. Basket: Bronze or stainless steel with 1/8- or 3/16-inch- diameter holes and lift-out handle.
 - 2. Female threaded ends for NPS 2 and smaller, and flanged ends for NPS 2-1/2 and larger.

2.3 KEY-OPERATION HYDRANTS

- A. General: ASME A112.21.3M, key-operation hydrant with pressure rating of 125 psig.
1. Inlet: NPS 3/4 or NPS 1 threaded or solder joint.
 2. Outlet: ASME B1.20.7, garden-hose threads.
 3. Operating Keys: Two with each key-operated hydrant.
- B. Nonfreeze Exposed-Outlet Wall Hydrants: ASSE 1019, self-drainable with integral nonremovable hose-connection vacuum breaker, casing and operating rod to match wall thickness, projecting outlet, and wall clamp.
1. Classification: Type A, for automatic draining with hose removed.
 2. Nozzle and Wall Plate Finish: Polished bronze.
- C. Nonfreeze Concealed-Outlet Wall Hydrants: ASSE 1019, self-drainable with flush-mounting box with cover, integral nonremovable hose-connection vacuum breaker, casing and operating rod to match wall thickness, concealed outlet, and wall clamp.
1. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
 2. Box and Cover Finish: Polished bronze.

2.4 TRAP SEAL PRIMER VALVES

- A. Supply-Type Trap Seal Primer Valves: ASSE 1018, water-supply-fed type, with the following characteristics:
1. Available Manufacturers:
 - a. Precision Plumbing Products, Inc.
 - b. Smith, Jay R. Mfg. Co.
 - c. Tyler Pipe; Wade Div.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Industries, Inc.; Jonespec Div.
 2. 125-psig minimum working pressure.
 3. Bronze body with atmospheric-vented drain chamber.
 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.
- B. Drainage-Type Trap Seal Primer Valves: ASSE 1044, fixture-trap, waste-drainage-fed type, with the following characteristics:
1. Available Manufacturers:
 - a. Smith, Jay R. Mfg. Co.
 - b. Watts
 - c. Zurn
 - d. Josam

2. Chrome-plated, cast-brass, NPS 1-1/4 minimum, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.

2.5 MISCELLANEOUS PIPING SPECIALTIES

- A. Water Hammer Arresters: ASSE 1010 or PDI-WH 201, metal-bellows type with pressurized metal cushioning chamber. Sizes indicated are based on ASSE 1010 or PDI-WH 201, Sizes A through F.
- B. Hose Bibbs: Bronze body with replaceable seat disc complying with ASME A112.18.1M for compression-type faucets. Include NPS 1/2 or NPS 3/4 threaded or solder-joint inlet, of design suitable for pressure of at least 125 psig; integral, nonremovable, drainable hose-connection vacuum breaker; and garden-hose threads complying with ASME B1.20.7 on outlet.
 1. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
 2. Finish for Service Areas: Rough bronze.
 3. Finish for Finished Rooms: Chrome or nickel plated.
 4. Operation for Equipment Rooms: Wheel handle or operating key.
 5. Operation for Service Areas: Wheel handle.
 6. Operation for Finished Rooms: Operating key.
 7. Include operating key with each operating-key hose bibb.
 8. Include integral wall flange with each chrome- or nickel-plated hose bibb.
- C. Fixture Supply Valves: Supply kits shall include chrome plated brass stops with full turn brass stem, (no plastic) chrome plated copper risers and shallow bell brass flange. Inlet shall be 1/2 inch. Outlet shall be 3/8 inch. Supply kit shall be certified by CSA or other recognized testing authority and bear manufacturer and testing mark. Stop to be certified to 200 psi line pressure.
- D. P-Traps: P-Traps shall be chrome plated cast brass body with cleanout, with 17 gauge seamless tubular wall bend, cast brass slip nuts. (No reducing washers), with shallow bell brass flange. P-Traps shall. Traps shall be certified by CSA or other recognized testing authority and shall bear manufacturer and testing mark.
- E. Sink Insulation Kits: Seamless Pre-wrapped all cast brass ground joint swivel P-Trap kit furnished with cast brass ground joint swivel P-trap with cleanout, seamless supply riser tube covers, supply angle stop covers and angle stop wheel handle covers.

PART 3 - EXECUTION

3.1 WASTE MANAGEMENT

- A. Follow the procedures and practices for waste separation, collection, and transport as defined in the Waste Management Plan specified in Section 01 74 19 "Construction Waste Management and Disposal."

3.2 INSTALLATION

- A. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.
- B. Provide double check backflow preventer on the main water service as detailed.

- C. Provide a detector check with Sensus meter on the fire protection water service.
- D. Provide reduced pressure type backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 - 1. Locate backflow preventers in same room as connected equipment or system.
 - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.
- E. Install strainers on supply side of each control valve, pressure regulator, and solenoid valve.
- F. Install trap seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- G. Install expansion joints on vertical risers, stacks, and conductors if indicated.
- H. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- I. Install cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below floors.
- J. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.
- K. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.
- L. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 2. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- M. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
 - 1. Install roof-drain flashing collar or flange so no leakage occurs between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 - 2. Position roof drains for easy access and maintenance.
- N. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.

- O. Fasten recessed-type plumbing specialties to reinforcement built into walls.
- P. Install wood-blocking reinforcement for wall-mounting and recessed-type plumbing specialties.
- Q. Install individual shutoff valve in each water supply to plumbing specialties. Use ball valve if specific valve is not indicated. Install shutoff valves in accessible locations. Refer to Division 22 Section "Valves" for general-duty ball, butterfly, and check valves.
- R. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- S. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.
- T. Provide insulated piping kits for all handicapped lavatories, hand sinks, and kitchen type sinks.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Connect plumbing specialties to piping specified in other Division 22 Sections.
- D. Ground equipment.
- E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- F. Connect plumbing specialties and devices that require power according to Division 16 Sections.

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain all plumbing equipment."

END OF SECTION 223000

SECTION 230010 - GENERAL MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Divisions 21, 22, and 23.

1.2 SUMMARY

- A. This Section includes general administrative and procedural requirements for Mechanical, Plumbing, and Fire Protection system installations. It is intended to supplement Division 1 sections. Any conflicts shall be brought to the attention of the Architect/Engineer for clarification.
- B. Furnish and install all work indicated and specified in accordance with these specifications and accompanying contract drawings. This shall include all required labor, materials, equipment, programming, testing, and supervision.

1.3 DEFINITIONS

- A. The following definitions used in mechanical and electrical sections are in addition to those listed in Supplementary General Conditions:
 - 1. Provide: Shall mean "furnish and install" indicated work
 - 2. Install: Installation of item and all necessary related work to provide fully operational devices.
 - 3. Furnish: Procurement and delivery to jobsite of equipment for installation.
 - 4. Remove: Disconnect and take from existing location, including accompanying sealant, supports, anchors, and associated materials, and remove from the site for legal disposal or recycling, or store and protect for reinstallation when noted.
 - 5. Replace: Remove and provide new.
 - 6. Re-install: Install existing item in same or new location as indicated. Provide all necessary hardware, supports, extension of existing services, etc as required.
 - 7. Herein: shall mean the contents of a particular section where this term appears.
 - 8. Indicated: Indicated on contract drawings.
 - 9. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, unpainted storage areas without ceilings, chases and shafts, attics, ceiling plenums, unexcavated spaces, crawl spaces, and tunnels.
 - 10. Exposed Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
 - 11. Exposed Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
 - 12. Concealed Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in walls or shafts.
 - 13. Concealed Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
 - 14. Listed or labeled shall mean as defined in NFPA 70 Article 100, by a Testing Agency acceptable to Authorities having jurisdiction (AHJ) and marked for intended use.
 - 15. Piping: Includes pipe, fittings, valves, hangers, and other accessories which comprise a system.

16. Wiring: Conduit, fittings, wire, junction and outlet boxes, switches, and items necessary or relating to such wiring.
17. Work: The labor, equipment, and materials required as part of the project.
18. Trades: refers to those specifically skilled in the work performed under a particular section of this contract.

1.4 CONTRACTOR

- A. The term Contractor as used throughout this Division of the Specifications shall be understood to mean the single Prime Contractor or firm awarded the single Contract for the project. References to various other contractor entities (i.e. 'Sub-', 'Mechanical', 'Plumbing', 'Electrical', 'Automation', 'BAS', etc) shall be understood to mean a sub-contractor to the Prime Contractor; if applicable.

1.5 DRAWINGS

- A. The Mechanical work is generally indicated on the Mechanical, Plumbing and/or Fire Protection drawings, but additional related information and details may appear on other project drawings, and these shall become a part of each Contract. All project drawings are intended to be complimentary.
 1. Refer to the Architectural drawings, when applicable, for information such as locations of fire rated assemblies, ceiling types and heights, chase dimensions, structural steel dimensions, etc.
 2. The Architectural Drawings and details shall govern the location and arrangement of equipment, mounting heights, and similar conditions within finished spaces.
 3. Notify the Architect of any discrepancies between any of the drawings and/or the specifications.
- B. The Drawings are diagrammatic in nature and indicate the general configuration of the work. All work that will be required for the actual installation is not necessarily indicated due to the scale of the drawings. Coordinate the actual installation of all work with all other building system components and other Contractors, and provide all necessary coordination, offsets, accessories, materials, etc. as part of the work.

1.6 TRUE INTENT

- A. The Drawings and Specifications are intended to describe a complete operating system. All labor, material or equipment, which is not specified or indicated but is necessary for the operation and completion of a properly operating system, according to the true intent of the Specifications and Drawings and as interpreted by the Architect/Engineer, shall be furnished as a part of the Contract, as though it were specifically detailed and described.
- B. Coordinate and assign work such that all work and materials are provided and coordinated between all subcontractors and suppliers to provide complete and operational systems. The specification format, section numbers and drawing numbering or nomenclature is not intended to assign work within the Contract.

1.7 EXAMINATION OF THE SITE

- A. Bidders shall carefully examine specifications and drawings, visit the site of proposed work and observe all existing conditions and limitations and include any work required due to the existing conditions and limitations.

- B. Request clarifications from the Architect/Engineer regarding discrepancies between existing conditions and drawings and specifications prior to bidding. Submission of a bid shall indicate that bidder is familiar with existing conditions to be met in execution of the work and has included such work in his bid.
- C. Failure to visit and inspect the existing conditions shall not be a valid reason for authorization of a change order.

1.8 DIMENSIONS, GRADES AND SURVEYS

- A. Dimensions, grades, elevations and locations shown on the Drawings are approximate. Verify all lines, grades and dimensions prior to starting the work. All necessary measurements, surveys, lines, grades, and elevations are the responsibility of the Contractor. Verify all lines and grades with the local controlling agency, AHJ or other party where required.

1.9 PERMITS, FEES AND CODES

- A. Perform all work in compliance with the codes, laws, ordinances, rules or regulations of federal, state, or local Authorities Having Jurisdiction over the premises. All such codes, laws, ordinances, rules and regulations are hereby incorporated and made a part of these specifications.
- B. Work shall be done in accordance with, but not limited to, the applicable sections of the latest edition and supplement to the following Codes and Standards:
 - 1. ANSI American National Standard Institute
 - 2. ASTM American Society for Testing and Materials
 - 3. FM Factory Mutual Systems
 - 4. NEMA National Electrical Manufacturers Association
 - 5. NFPA National Fire Protection Association
 - a. 13 - Sprinkler Systems
 - b. 50 - National Electric Code
 - c. 54 - National Fuel Gas Code
 - d. 90A - Installation of Air-conditioning and Ventilating systems
 - e. 91 - Blower and Exhaust Systems
 - 6. UL Underwriters Laboratories, Inc.
 - 7. SMACNA Sheet Metal and Air Conditioning Contractors' National Association
 - 8. IBC International Building Code
 - 9. IMC International Mechanical Code
 - 10. IPC International Plumbing Code
 - 11. All relevant sub-codes adopted by the local AHJ.
- C. The drawings and specifications are not intended to conflict with the above documents. Request clarifications from the Architect/Engineer regarding discrepancies between relevant codes and the drawings and specifications prior to bidding. Submission of a bid shall indicate that bidder is familiar with the applicable code requirements and has included such work in the bid.
- D. All work performed on this project and all equipment furnished for this project shall be in conformance with the regulations and requirements of the Occupational Safety and Health Act (OSHA). The Contractor is solely responsible for compliance with OSHA regulations. All purchased equipment shall be designed, manufactured, and furnished with the necessary accessories to meet OSHA requirements.

All construction facilities, including ladders, platforms, guard rails, safety features, etc. shall meet OSHA requirements.

1.10 DAMAGES

- A. Contractor is responsible to repair or replace damage caused by employees to the site, building or building mechanical/electrical systems during the execution of the work. Repairs or replacement shall be completed to the satisfaction of the Architect/Engineer and Owner.
- B. The above paragraph applies to damages which occur to existing conditions (portions of the building in place before renovations) or new work installed during the progress of the project.

1.11 MATERIALS AND EQUIPMENT

- A. All materials and equipment shall be new, and shall conform to the grade, quality and standards specified.
 - 1. Where required by applicable bidding requirements and Division 1 sections, materials and equipment shall meet applicable USA steel certifications and/or shall be manufactured in the USA.
- B. All equipment shall be limited to products regularly produced for the intended service, in accordance with manufacturer's engineering data, rating, and literature. Major items of equipment shall be manufactured for the intended purpose in commercial practice and shall have the manufacturer's name, address and catalog number affixed in a prominent place.
- C. Equipment shall be installed in strict accordance with manufacturer's instructions for type and capacity of equipment used. Manufacturer's instructions shall be considered part of the specifications. Type, capacity and application of equipment shall be suitable and shall operate satisfactorily for the purpose intended.
- D. Equipment used as the basis-of-design as indicated on the Drawings defines the general space requirements, weights and related services (electrical services, piping connections, etc.). Provide equipment of similar size, requirements and clearances which shall not necessitate revisions to the building construction or other trades. If revisions are required due to substitution the Contractor shall pay all costs for any required revisions. No revisions shall be made without Architect/Engineer's written approval.

1.12 PERFORMANCE OF EQUIPMENT

- A. All materials, equipment and systems specified or required for the completion of the work, shall be completely satisfactory and acceptable in operation, performance, and capacity. No approval, either written or verbal, of any drawings, descriptive data of samples of such material, equipment and/or appurtenances, shall relieve the Contractor of his responsibility to provide systems in complete working order at the completion of the work.
- B. Any material, equipment, or appurtenances, which does not comply with the drawings and/or specification requirements, or which is not new, or which is damaged prior to acceptance by the Architect/Engineer, shall be removed and replaced with acceptable materials, equipment and/or appurtenance or put in acceptable working condition, to the satisfaction of the Architect/Engineer.
- C. All equipment and systems shall be electrically and mechanically correct. All equipment and systems shall operate without objectionable noise or vibration as determined by the Architect/Engineer. Eliminate

any objectionable noise or vibration produced and transmitted to occupied portions of the building by any system or equipment, to the satisfaction of the Architect/Engineer and Owner.

1.13 CUTTING AND PATCHING

- A. All Cutting and Patching shall be completed in accordance with Division 1, Cutting and Patching section.
- B. General: All cutting and patching shall be done by mechanics experienced in their respective lines of work.
 - 1. All cutting shall minimize damage to adjacent surfaces. If damage occurs the Contractor shall replace or repair the damaged materials with new materials in a manner approved by the Architect/Engineer.
 - 2. When necessary to cut and remove portions of any walls, floors, ceilings, roof or site work to perform the work, Contractor shall perform cutting and fitting, remove all excess material, and patch or replace all damaged construction in a manner approved by the Architect/Engineer.
 - 3. No cutting shall be done which may affect the building structurally or architecturally. Any damage incidental to cutting or other causes in the performance of this Contract shall be made good by replacement or repairs. Cutting shall be done only with the prior approval of the Architect.
 - 4. Patch all openings left in existing walls, floors and ceilings when obsolete materials are removed. Match adjacent construction and finishes.
- C. Patch and/or seal all openings or penetrations made in fire rated floors, ceilings or partitions after work has been installed. The material used for sealing the openings shall have a fire rating equal to or greater than the rating of the floor, ceiling or partition material. All fire sealant material shall be U.L. classified and approved by the Architect/Engineer.

1.14 RUBBISH REMOVAL AND CLEAN-UP

- A. Periodically, and at the completion of the work, remove from the building and site all rubbish and accumulated materials, and leave the workplace in a clean, orderly and acceptable condition. Provide dumpsters, trash containers, hauling and approved disposal fees associated with the work.
- B. Clean all installed materials and equipment of paint splashes, grease stains, dust, finger marks, and all other unsightly marks prior to substantial completion inspection.

1.15 TESTS AND CERTIFICATIONS

- A. The following requirements are supplementary to test requirements specified in individual equipment or systems Sections.
 - 1. Written notice of test date shall be given to Architect/Engineer and other parties at least 72 hours prior to tests.
 - 2. Concealed work shall remain uncovered until required tests have been completed
 - 3. Conduct preliminary test of equipment as soon as conditions permit. Make changes, adjustments, or replacements based on test results prior to final acceptance tests.
 - 4. Conduct performance and operating tests for each system or equipment in presence of the Architect/Engineer. Coordinate testing with the manufacturer's representative and/or AHJ when required.
 - 5. Furnish labor, material, and instruments and include all other costs in connection with tests.

6. Obtain certificates of approval and/or acceptance in compliance with regulations of AHJ. Work shall not be complete until such certificates have been delivered to the Architect/Engineer and Owner.

B. Contractor shall certify after testing that all systems and equipment operate safely, efficiently, and in accordance with manufacturer's instructions and the intent of the drawings and specifications.

1.16 PROTECTION AND CLEANING

A. Protect work and materials against dirt, water, chemicals, plaster or damage. All openings in stored or installed materials (pipes, ductwork, conduit, etc.), shall be sealed to exclude dirt, sand, and other foreign substances. Any damaged materials shall be removed and replaced regardless of the cause of the damage.

B. Protect all surfaces against damage from welding, cutting, burning, soldering or similar construction functions. Special care shall be directed to exposed finished masonry, metal or wood surfaces, painted surfaces, finished flooring, and finished ceilings.

C. Any damage caused by Contractor's neglect or by the elements due to the Contractor's neglect, either to existing work, or to his work shall be repaired or replaced in a manner approved by the Architect/Engineer.

D. Clean all materials and equipment to remove all paint, grease, oil, scale, rust, dirt, mud, dust, sand, and other foreign material prior to substantial completion inspection. Remove traces of any cleaning materials. Clean the interior of all cabinets, fixtures and equipment and remove dust, dirt and debris.

1.17 QUALITY OF WORKMANSHIP

A. All work shall be installed in a first class, neat and workmanlike manner by mechanics skilled in the trade involved. The quality of workmanship shall be subject to the approval of the Architect/Engineer. Any work of inferior quality and/or workmanship shall be corrected in a manner acceptable to the Architect/Engineer.

1.18 SUBSTITUTIONS

A. Various products are used as the Basis-of-Design for systems and equipment and are specified by a manufacturer's name and model number. Unless otherwise indicated, other manufacturer's products may be submitted for consideration as a substitution in accordance with the requirements set forth in Instructions to Bidders and/or Division 1 sections, and as follows.

1. The Architect/Engineer shall be the sole judge as to the acceptance of a product that is submitted for acceptance as a substitution.
2. The proposed substitute shall include all labor and materials required to install and operate the equipment in accordance with the original design concept, including the cost of any changes to work under this section, or other sections or Contracts, such as; access openings, equipment pads, supports, pipe or duct connections, motors, controls, electrical and control wiring.
3. Contractor shall verify that substitute equipment will fit into the designated spaces, verify that dimensions provide adequate space for the equipment and allow clearances for connections and servicing, and verify acceptance of any additional costs from other Contractors resulting from the substitute product, prior to submission to the Architect/Engineer for acceptance.

1.19 SUBMITTALS AND SHOP DRAWINGS

- A. General: Follow the procedures specified in Division 1 "Submittals".
- B. Prepare and submit a Submittal Schedule which shall include a list of products to be submitted and indicate the product manufacturer, model, and date the information will be submitted to the Architect/Engineer. The schedule shall be submitted within two weeks after notice-to-proceed and prior to the submission of individual product submittals.
- C. After acceptance of the Submittal Schedule, submit Shop Drawings and Submittals and obtain acceptance of the Architect/Engineer before any equipment is ordered or work is accomplished. Verify the required number of copies of each submittal to be submitted.
 - 1. Submittals shall be in the form of clearly legible manufacturers printed catalogs, CAD-generated drawings, pamphlets, technical data, test information, and installation instructions. Clearly indicate the location, service and function of each particular item. Identification shall be made in ink with specific model numbers highlighted and accessories highlighted.
 - 2. Submittals shall be completely referenced and identified. Descriptive information and data shall be complete. Submittals which only show partial or general information will not be acceptable and will be returned.
 - 3. Shop Drawings and Submittals which are prepared by sub-contractors and vendors shall be checked and coordinated by the Contractor prior to submission to the Architect/Engineer. Contractor shall check these drawings and submittals with respect to measurements, materials, identifications, and details so as to make certain that they conform to the intent of the Contract Documents and make any corrections before submission to the Architect/Engineer.
 - 4. Contractor shall inform the Engineer, in writing, of any deviations in the shop drawings and submittals where the submitted item deviates from the Contract Documents. This written advisory shall accompany the initial submittal and shall state the reasons for the deviations.
- D. The Architect/Engineer will check the Shop Drawings and Submittals for conformance with the Contract Documents. The Engineer's acceptance of the Shop Drawings and Submittals does not release the Contractor from providing all specific requirements of the equipment and installation not listed in the Submittal but required by the Contract Documents.
- E. Contractor shall be responsible for dimensions that are to be confirmed at the job site, for coordination in the ordering and assembly of systems and equipment, for information that pertains solely to fabrication processes or to techniques of construction, and for coordination of the work of all trades.
- F. The following specific items and information shall be included in all Shop Drawings and Submittals:
 - 1. Capacity and performance data as shown on the Equipment Schedules or as specified.
 - 2. Complete descriptive data on the systems, equipment and specialties which are specified, scheduled, or shown, so that compliance with the Contract Documents can be determined.
 - 3. Electrical wiring diagrams (power and control) for electric motor driven equipment.
- G. Systems and equipment which have been installed without having been accepted by the Architect/Engineer may be rejected and be shall be replaced with products that are acceptable. Submittals and Shop Drawings used at the construction site shall have Architect/Engineer's acceptance stamp.
- H. Shop Drawings and Submittals shall be revised and submitted as often as necessary to obtain acceptance. Contractor shall not delay the progress of the work due to unnecessary delays in obtaining acceptance of all required Shop Drawings or Submittals.

1. Resubmit rejected Shop Drawings and Submittals within three weeks, or sooner if required by project schedule.
 2. During the submittal process, obtain all of the information that will be required for the Operation and Maintenance Manuals.
- I. Ductwork Shop Drawings: Ductwork drawings shall be based on approved Architectural, Structural, and Mechanical shop drawings and equipment submittals which relate directly to the installation of the Mechanical Systems. Contractor shall also rely on job conditions, the equipment that will be installed and actual field measurements in the preparation of the shop drawings.
1. The ductwork shop drawings shall clearly depict structural steel, grids, lights, sprinkler systems, and plumbing and HVAC piping mains in order to avoid interferences with structural steel, walls, and ceiling systems.
 2. Shop drawings shall show the dimensions of the equipment and the relationship of equipment to walls, floors, and ceilings. The shop drawings shall be prepared on at least 24" x 36" sheets at a minimum scale of 1/4" = 1'-0".

1.20 COORDINATION AND COORDINATION DRAWINGS

- A. General: Follow the procedures specified in Division 1 "Coordination Drawings".
- B. All Contractors and sub-contractors shall coordinate the installation of all equipment and material. The Contractors shall hold weekly scheduling and coordination meetings during the construction process. If conflicts are found, and they cannot be worked out in the field, they shall be brought to the attention of the Architect/Engineer.
- C. Layout of building systems, equipment, fixtures, piping, ductwork, conduit, specialty items, and accessories indicated on the Contract Drawings is diagrammatic. Variations in alignment, elevation, and detail will be required to avoid interference and satisfy architectural and structural limitations. All such variations are not necessarily indicated.
- D. Coordination drawings shall be prepared, reviewed and coordinated in advance of any work being performed in any area. The drawings and coordination shall follow the project phasing schedule where applicable.
1. A coordination drawing completion schedule shall be prepared by the Mechanical Contractor and agreed upon by all Contractors and sub-contractors. The initial coordination drawings shall be prepared within thirty days of receipt of the General Contractor's base ceiling drawings.
 2. Upon completion and sign-off by all Contractors, submit final coordination drawings to Architect/Engineer for review and acceptance.
- E. Prepare coordination drawings to a scale of 1/4"=1'-0" or larger; detailing all elements, components, and systems of equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for 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. Prepare plans, sections and elevations to indicate the proposed locations of fixtures, piping, ductwork, conduit, equipment, and materials. Include the following:
 - a. Clearances for installing and maintaining insulation.
 - b. Clearances for servicing and maintaining equipment, including access door openings and component removal

- c. Equipment connections, mounting and support details.
 - d. Exterior wall and foundation penetrations.
 - e. Fire-rated wall and floor penetrations.
 - f. Sizes and locations of equipment pads and bases.
 2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
 3. Order of priority for construction space:
 - a. Maintain scheduled finished ceiling height.
 - b. Light fixtures
 - c. Drainage piping (gravity flow).
 - d. Ductwork.
 - e. Cable trays
 - f. Fire protection piping.
 - g. Other piping.
 - h. Conduit.
- F. Prepare overall coordinated reflected ceiling plans which shall include, but not be limited to, air outlets and inlets, light fixtures, communication systems components, sprinklers, access doors, and other ceiling-mounted equipment or items.
 1. The Contractor shall prepare the base ceiling plans. Each contractor shall use these base ceiling drawings to indicate their work on a composite reflected ceiling plan. The Mechanical Contractor shall obtain copies of the General Contractor's base ceiling plans, and copies of all other contractors' or sub-contractors' reflected plans and use them to prepare composite plans.
 2. All Contractors and sub-contractors shall carefully check all of the drawings and coordinate their work with all other trades to provide a symmetrical and coordinated ceiling. Ceiling T-bars, lights, diffusers, and other equipment shall all be symmetrically installed with provisions made for integrating the T-bars and the various equipment. Failure to coordinate the work will result in relocation of ceiling components as directed by the Architect/Engineer at the Contractor's expense.
 3. The Mechanical Contractor shall obtain copies of Contractors' and sub-contractors' coordination drawings to insure that all installations are coordinated and no conflicts exist. The Mechanical Contractor shall utilize the structural steel drawings to coordinate installation of material and equipment in the ceiling spaces and in chases. Failure to coordinate the work will result in relocation of components as directed by the Architect/Engineer at the Contractor's expense.

1.21 ALIGNMENT

- A. Where several devices, panels, controllers, bells, alarms, thermostats, switches, handles, etc., are to be installed in a common location, this equipment shall be lined up in a horizontal or vertical plane. Request interpretation from the Architect/Engineer for any unusual alignment conditions.

1.22 RECORD DRAWINGS

- A. General: Follow the procedures specified in Division 1 "Record Documents".
- B. In addition to the requirements specified in Division 1, indicate the following installed conditions:
 1. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 2. Approved substitutions, Contract Modifications, and actual equipment and materials installed. Revise schedules on the drawings.

3. Exterior underground equipment and materials located with triangulated dimensions.

1.23 OPERATION AND MAINTENANCE MANUALS

- A. Prepare and provide minimum of three (3) maintenance manuals in accordance with Division 1 “Operation and Maintenance Data”.
- B. In addition to the requirements specified in Division 1, include the following information for equipment items:
 1. Written description of system operation.
 2. An equipment list for each piece of equipment furnished. The list shall be in order of equipment label and shall indicate the manufacturer, model number, serial number, and motor horsepower and voltage ratings.
 3. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and list of replacement parts.
 4. A copy of all final corrected equipment submittals, control diagrams, descriptive brochures, and a list of all parts of each piece of equipment.
 5. 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.
 6. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions, and lubrication charts and schedules
 7. Copies of all permits required for occupancy.
- C. All of the materials shall be indexed, arranged categorically, and be bound in a rigid, plastic covered, three ring binder. Provide tabs for each major section.
- D. The purpose of this manual is to assist the Owner in routine operation, maintenance, servicing, trouble shooting and procurement of replacement parts. All information in the manual shall be as-built and only material pertinent to the project shall be included.

1.24 TRAINING AND INSTRUCTIONS

- A. General: Follow the procedures specified in Division 1 "Demonstration and Training".
- B. At the completion of the work, and before final acceptance of the building by the Owner, each Contractor, together with manufacturers’ representatives, shall instruct the Owner’s designated representatives in the care, adjustment, maintenance and operation of equipment and systems in accordance with Division 1.
- C. A manufacture’s representative of each major component or system shall inspect his work, make final adjustments, place them in a satisfactory working condition, and instruct the owner in their operation. Each representative shall also provide a letter to the Architect/Engineer indicating that an inspection has been performed, instruction given, and the equipment is installed and operating in conformance with the manufacturer’s written installation instructions.

1.25 GUARANTEES AND WARRANTIES

- A. All work performed shall be guaranteed in writing by the Contractor for a period of one (1) year after substantial completion. The Contractor shall remedy any defects due to faulty materials or workmanship,

and pay for any damage to other work resulting there from which appear within a period of one (1) year from date of occupancy or the date of the Owner's Certificate of Final Payment of the total contract, and in accordance with the terms of any special guarantees provided in the Contract. The Owner shall give notice of observed defects with reasonable promptness. All questions arising under this article shall be decided by the Owner notwithstanding final payment.

1.26 TEMPORARY HEAT

- A. New HVAC equipment may be used for temporary heat if allowed in Division 1 and provided the following conditions are met:
1. HVAC unit warranty is not reduced. Warranty period begins at date of substantial completion.
 2. Building is not excessively dusty.
 3. The HVAC equipment is installed as part of the permanent HVAC systems as indicated on the Drawings.
 4. All equipment and ductwork shall be cleaned to new condition prior to substantial completion.
 5. All return air grilles and/or return duct openings shall be provided with MERV-8 filtration media to minimize airborne contaminants from entering the return air ductwork system. This filtration media shall be changed on a regular basis, as needed. Inspection of filtration media will take place during routine construction reviews by the engineer. At the completion of work, the filtration media shall be removed. At the completion of work, the Contractor shall provide new filtration media within the main air handler.
 - a. 2" MERV-8
 - b. 4" MERV-13
- B. Remove all temporary heating materials, equipment, hardware, accessories etc. when it is no longer required, and prior to substantial completion.

1.27 METHOD OF PROCEDURE

- A. The Drawings accompanying these Specifications are diagrammatic and intended to indicate the approximate and relative locations of the materials and systems. Installation, connection, and inter-connection of all components of the systems shall be complete and made in accordance with the manufacturer's instructions and best practices of the respective trades.
- B. Install all work and equipment at such time and in such manner as not to delay or interfere with any other trade performing work.
- C. Coordinate with all trades as to the locations of different lines of pipe, ducts, conduit, and electrical equipment before erecting any Work, so as to avoid interference. In case of conflict, equipment shall be relocated, without additional cost, as directed by the Engineer regardless of which equipment was installed first. Each Contractor shall cooperate with other Contractors for the proper securing and anchoring of all Work included within these Specifications.
- D. Care shall be used in the erection and installation of all equipment and materials to avoid marring surfaces of the work of other Contractors. Each Contractor will be held responsible for all such damage caused by the lack of precaution and due to negligence on the part of his workmen.
- E. 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 several branches 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.

1.28 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 Architectural interior and exterior elevations and equipment specifications for rough-in requirements.

1.29 MECHANICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of systems, materials, and equipment. Comply with the following requirements:
 - 1. Coordinate systems, equipment, and materials installation with other building components.
 - 2. Verify all dimensions by field measurements.
 - 3. Arrange for chases, slots, and openings in other building components during progress of construction.
 - 4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
 - 5. Sequence, coordinate, and integrate installations of materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
 - 6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 - 7. Coordinate connection of systems with utilities and services. Comply with requirements of governing regulations, service companies, and controlling agencies. Provide required connection for each service.
 - 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/Engineer.
 - 9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
 - 10. Install 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. Extend grease fittings to an accessible location.
 - 11. Install access panel or doors where units are concealed behind finished surfaces.
 - 12. Install materials and equipment firmly supported and secured to the building construction where required, and according to manufacturer's instructions
 - 13. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 230010

SECTION 230030 - ELECTRICAL REQUIREMENTS FOR EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This section specifies the basic requirements and responsibilities for motors, motor controls, and electrical work related to equipment furnished under Division 23.
 - 1. The General Contractor has final responsibility for coordination of all work and responsibilities between sub-contractors and installers.
- B. Electrical products furnished under Division 23 shall comply with Part 2 – Products below and with applicable Division 26 sections.
- C. Refer to the drawings or specifications for the specific electrical requirements (i.e. horsepower, kilowatts, voltage and electrical characteristics) for equipment furnished.

1.3 REFERENCES

- A. NEMA Standards MG 1: Motors and Generators
- B. NEMA Standards ICS 2: Industrial Control Devices, Controllers, and Assemblies.
- C. NEMA Standard 250: Enclosures for Electrical Equipment
- D. NEMA Standard KS 1: Enclosed Switches
- E. NFPA Bulletin 70: National Electrical Code, latest addition or as adopted by the local AHJ.

1.4 SUBMITTALS

- A. Submit product data for motors, starters, and other electrical components, as required by the individual equipment specification sections.
 - 1. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes
 - 2. Include power, signal, and control wiring diagrams. Differentiate between manufacturer-installed and field-installed wiring.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

- A. Confirm that voltage and amperage characteristics of equipment to be installed match those indicated on the electrical drawings. Notify the Architect/Engineer immediately of any discrepancies. Do not proceed with any installation work which conflicts with the drawings.
- B. Distribute and coordinate the product information which requires electrical coordination with the electrical contractor or sub-contractor and per Division 1 requirements.
 - 1. The electrical contractor or sub-contractor shall obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other Divisions. The electrical contractor or sub-contractor will confirm that voltage and amperage characteristics of equipment to be installed match those indicated on the drawings.
- C. Coordinate sequence rough-in of electrical connections to coordinate with installation schedule and startup of equipment.
- D. Refer to the "Electrical Responsibilities Schedule" on the drawings for Electrical/Mechanical coordination of work

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to the compliance with these specifications, the following manufacturers may provide equivalent products to the basis of design; however, in the event that incorporation of an equivalent item into the work requires revisions or additions to other trades, coordinate the installation and bear all costs, at no change in the Contract Sum.
 - 1. Square D Company
 - 2. Siemens
 - 3. Eaton/Cutler-Hammer
 - 4. Allen Bradley
 - 5. Franklin Control Systems
 - 6. Or approved equal

2.2 MOTORS

- A. General Motor Requirements:
 - 1. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
 - 2. Comply with NEMA MG 1 unless otherwise indicated.
- B. Polyphase Motors:

1. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.
 2. Motor sizes shall be large enough so that the driven load brake horsepower will not require the motor to operate in the service factor range.
 3. Temperature Rating: Rated for 40 degrees C. environment with maximum 50°C temperature rise for continuous duty at full load (Class A Insulation).
 4. Starting capability: Frequency of starts as indicated by automatic control system, and not less than 5 evenly time spaced starts per hour for manually controlled motors.
 5. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors.
 6. Efficiency: Premium efficient, as defined in NEMA MG 1.
 7. For special motors, more detailed and specific requirements are specified in the individual equipment specifications.
- C. Motors Used with Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
1. Two-speed motors shall have two separate windings on poly-phase motors.
- D. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with, and approved by, VFC manufacturer.
1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- E. Single Phase Motors:
1. Motors 1/20 hp and Smaller: Shaded-pole type.
 2. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1) Permanent-split capacitor.
 - 2) Split phase.
 - 3) Capacitor start, inductor run.
 - 4) Capacitor start, capacitor run.
 3. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
 4. Bearings: Pre-lubricated, antifriction ball bearings or sleeve bearings.
 5. 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.

2.3 MOTOR STARTERS

A. General Motor Starter Characteristics:

1. Enclosures: lockable NEMA 1, general purpose enclosures, except in wet locations shall be NEMA 4 with conduit hubs, or units in hazardous locations which shall have NEC proper class and division.

2. Type and size of starter shall be as recommended by motor manufacturer or the driven equipment manufacturer for applicable protection and start-up condition.

B. Manual Starters, fractional horsepower single phase

1. Square D Class 2510; Type 'FG5' (single pole) or 'FG6' (two pole), or equal
2. Toggle operator, number of poles required by load
3. NEMA '1' enclosure, unless otherwise noted
4. Green 'ON' pilot light in cover
5. Overload protection: melting alloy type thermal overload relays.
6. Handle guard kit with padlock provision.

C. Magnetic Starter, polyphase

1. Square D Class 8536 Form H30 or equal, full-voltage non-reversing unless noted
2. Full-voltage starter with solid-state "motor-logic" relay with adjustable trip current, to provide overload protection, phase loss and phase imbalance protection
3. NEMA '1' enclosure, unless indicated or required by application
4. Hand-Off-Auto selector switch mounted on cover.
5. 24 volt or 120 volt control transformer, fused from line side.
6. Externally operated manual reset.
7. Green 'on' pilot light in cover.
8. N.O and N.C. auxiliary contacts

2.4 SMART STARTERS

- A. General: "Smart Starter" combination motor starters include integrated control logic, wiring terminals, electronic overload protection, internal disconnect means, and other features as specified below.

1. Manufacturer shall provide a five year warranty on the complete starter assembly.
2. The starter assembly shall be UL listed under UL 508A

B. Single Phase Combination Starter; Franklin Control Systems BAS-1P or equal

1. Ratings: 110 volt or 208/240 VAC single phase motors from 0.1 HP to 1.0 HP.
2. Manually-operated quick-make toggle mechanism lockable in the "off" position to function as the motor disconnect.
3. Electronic adjustable overload protection with manual reset
4. LED pilot lights for 'run' and 'fault' status.
5. Hand-Off-Auto switch, concealed behind cover.
6. Controls: provide an interposing run relay and current sensing status output relay.
 - a. Wiring terminals allow for remote control run (ON/OFF) input.
 - b. Wiring terminals available for run status output and fault output.
 - c. All control terminals shall be integrated in the starter.
7. Provide surface mount enclosure for mounting to a single-gang box.

2.5 DISCONNECT SWITCHES

- A. General: Furnish disconnect "safety" switches in types, sizes, duties, features, ratings, and enclosures as required or indicated.

1. NEMA 1 enclosure for indoor switches
 2. NEMA 4 enclosure with raintight hub, for outdoor switches.
 3. For motor disconnects, provide units with horsepower ratings suitable for the loads served.
- B. Non-fusible switch: heavy duty switches, voltage classes and current ratings as required or indicated; Square “D” Class 3110 or equal.
1. Single throw externally-operable handle, quick-make/quick-break mechanism, interlocked hinged cover, equipment grounding kit.
 2. Provide number and arrangement of auxiliary interlock contacts in switches when indicated.
- C. Fusible switch: heavy duty switches, voltage classes and current ratings as required or indicated; Square “D” Class 3110 or equal.
1. Single throw externally-operable handle, quick-make/quick-break mechanism, interlocked hinged cover, equipment grounding kit, fuseholder clips with Class H fuses (unless indicated), and current ratings indicated.
 2. Provide number and arrangement of auxiliary interlock contacts in switches when indicated.
- D. Toggle disconnect switch (for fractional horsepower motors with internal overload protection, maximum 1 HP/16 FLA); Hubbell HBL1221B (brown)
1. Single or double-pole industrial grade toggle switch, non-fused, nylon handle, one-piece bridge
 2. 20 amps, 120/208/240/277 volts
 3. Single-gang box with galvanized cover plate and integral guard with padlock provision.
- E. In-line plug-type motor disconnects may be furnished for fractional horsepower motor disconnects where specified as part of equipment.

2.6 COMBINATION MAGNETIC MOTOR STARTER/DISCONNECT

- A. Provide device with same features as magnetic motor starters and disconnect switches as specified above, in common enclosure.
1. Square D Class 8536 Form H30 or approved equal, full-voltage non-reversing unless noted.
 2. Full-voltage starter with solid-state “motor-logic” relay with adjustable trip current, to provide overload protection, phase loss and phase imbalance protection
 3. Single throw externally-operable handle, quick-make/quick-break mechanism, interlocked hinged cover, equipment grounding kit.
 4. NEMA ‘1’ enclosure, unless indicated or required by application
 5. Hand-Off-Auto selector switch mounted on cover.
 6. 24 volt or 120 volt control transformer, fused from line side.
 7. Externally operated manual reset.
 8. Green ‘on’ pilot light in cover.
 9. N.O and N.C. auxiliary contacts

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate installation with electrical installer. Provide copies of approved shop drawings for equipment to be wired.
- B. Follow manufacturer's installation instructions.

3.2 ELECTRICAL CONNECTIONS

- A. All electrical power connections to equipment will be made by the electrical contractor or sub-contractor (EC), through the remote starter and/or remote disconnect where indicated.
- B. Motors and motor controls for equipment shall be furnished and set by the mechanical contractor or sub-contractor (MC) as work of Division 23. Field-installed disconnects, starters, or variable speed controllers shall be furnished by the MC and installed and wired by the EC.
- C. The contractor or sub-contractor furnishing the motorized equipment shall coordinate and supervise start up and testing of equipment.

3.3 ELECTRICAL RESPONSIBILITY AND COORDINATION

- A. The MC shall check each piece of equipment or motor for alignment, lubrication, etc. The electrical contractor will test each motor for proper rotation after final connections are completed and before applying current to the motor. The EC will make any necessary adjustments to the starter and control equipment for proper starting and overload protection.
- B. The mechanical contractor or sub-contractor (MC) shall furnish all mechanical/HVAC equipment, motors, starters, thermal overloads, push buttons for local and remote control, controllers, pressure switches, aquastats or similar items together with all temperature/building automation appurtenances, accessories and control wiring required to operate the equipment furnished under the Division 23 sections of the contract, and as necessary to perform the operating functions as specified, shown on the drawings or as otherwise required.
- C. The MC shall set and mount all mechanical/HVAC equipment, motors, starters, variable frequency controllers, and control panels and devices. The electrical contractor or sub-contractor (EC) will, unless noted otherwise, furnish and install all safety switches at the equipment and make all power wiring connections (120 volts and above) to equipment or motors through the safety disconnect switch, remote motor starter, or line voltage control device (thermostat, etc.). Where the starter and/or safety switch is an integral part of the equipment assembly, the assembly shall be furnished with the wiring being complete between the starter, controller and motor and the EC will make the power connections only at the unit.
- D. If procurement requirements necessitate a change in the electrical characteristics of any motor or equipment being furnished under Division 23, the MC shall first obtain approval of such changes from the Engineer. The MC shall also be responsible for all necessary arrangements and shall pay all costs, if any, for all required changes to the electrical work.
- E. The EC will furnish, install and connect all power wiring to designated control panel locations. The MC and/or MC's temperature control subcontractor shall furnish, install and connect all low voltage (24 volts) control wiring to all equipment controls and appurtenances provided under Division 23, unless otherwise specified herein or indicated on the drawings.
- F. Refer to the Electrical Responsibility Schedule on the drawings for additional information on responsibilities for providing starters, disconnects and controls.

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G. The EC shall be responsible for proper rotation of three phase equipment.

END OF SECTION 220030

SECTION 230050 – BASIC MATERIALS AND METHODS (MECHANICAL)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and other Division 23 Sections.

1.2 SUMMARY

- A. This Section includes limited scope general construction materials and methods and common materials for mechanical installations as follows:

- 1. Common Piping System Requirements
- 2. Materials and installation
 - a. Transition fittings
 - b. Dielectric fittings and unions
 - c. Solder
- 3. Miscellaneous metals and lumber.
- 4. Painting and finishing
- 5. Sleeves and seals
 - a. Sleeves
 - b. Mechanical sleeve seals
 - c. Escutcheons
- 6. Joint sealers
- 7. Firestop systems
- 8. Equipment installation requirements.
- 9. Supports and anchors.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
 - 2. PE: Polyethylene plastic.
 - 3. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For all specified materials and products:
- B. Shop Drawings: Detailed fabrication and installation drawings for supports and anchorages.
- C. Firestop: For each firestop system show construction conditions, relationships to adjoining construction, dimensions, description of materials, component connections, anchorage methods, hardware and installation procedures, plus the following:
 - 1. Firestop design designation of testing and inspecting agency acceptable to authorities having jurisdiction that confirms compliance with requirements for each condition.
- D. Welding certificates.

1.5 PROJECT CONDITIONS

- A. Maintain and protect existing building services, which transit the area affected by selective demolition. Provide temporary utility services to affected areas.
- B. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, undermining, washout, and other hazards created by excavation operations.
- C. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits permitted by the joints sealer manufacturer. Do not apply joint sealers to wet substrates.

1.6 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

PART 2 - PRODUCTS

2.1 PIPE, TUBE AND FITTINGS

- A. Refer to individual piping Sections for application requirements for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAgl, silver alloy for refrigerant piping, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.3 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - e. Or approved equal.

2. Sealing Elements: EPDM or NBR 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 Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.4 SLEEVES

A. Description: Sleeves

1. Manufacturers:

- a. Advance Products & Systems, Inc.
- b. Calpico, Inc.
- c. Metraflex Co.
- d. Pipeline Seal and Insulator, Inc.
- e. Or approved equal.

- B. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- C. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- D. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- E. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 1. Underdeck Clamp: Clamping ring with set screws.

2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
 1. Manufacturers:
 - a. Central Plastics Company.
 - b. Epcos Sales, Inc.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Zurn Industries, Inc.; Wilkins Div
 - e. Or approved equal.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

1. Manufacturers:
 - a. Central Plastics Company.
 - b. Epco Sales, Inc.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Or approved equal.

- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - e. Or approved equal.

 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
 1. Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
 - c. Victaulic
 - d. Or approved equal.

- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F .
 1. Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.
 - e. Or approved equal.

2.6 MISCELLANEOUS METALS AND LUMBER

- A. Miscellaneous metal shall be as follows:
 1. Steel plates, shapes, bars, and bar grating: ASTM A 36.
 2. Cold-Formed Steel Tubing: ASTM A 500.
 3. Hot-Rolled Steel Tubing: ASTM A 501.
 4. Steel Pipe: ASTM A 53, Schedule 40, welded.
 5. Fasteners: Zinc-coated, type, grade, and class as required.

B. Miscellaneous lumber shall be as follows:

1. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPB rules or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.
2. Construction Panels: Plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less than 15/32 inches.

2.7 FIRESTOP SYSTEMS

A. General:

1. Architect/Engineer must approve in writing any alternates to the firestop systems and materials specified herein.
2. Compatibility: Provide firestop systems that are compatible with one another, with the substrates forming openings, and with the items penetrating through the firestop system, under conditions of service and application, as demonstrated by the firestop system manufacturer based on testing and field experience.
3. Accessories: Provide components for each firestop system to install fill materials and to comply with the UL listing. Use only components specified by firestop systems manufacturer and approved by the qualified testing and inspecting agency.
 - a. Permanent forming/damming/backing materials
 - b. Temporary forming materials.
 - c. Substrate primers.
 - d. Collars and steel sleeves.
4. Manufacturers; Specified product or equal by
 - a. Hilti or
 - b. 3M
 - c. Specified Technologies Inc.
 - d. Dow Corning
 - e. Or approved equal
5. Architect/Engineer must approve in writing any alternates to the firestop systems and materials specified herein.

B. Through-Penetration Firestop Systems:

1. Systems or devices listed in the UL Fire Resistance Directory under categories XHCR (firestop devices) and XHEZ (firestop systems) may be used, providing that they conform to the construction type, penetrant, type, annular space requirements and fire rating involved in each separate instance, and that the system is symmetrical for wall applications. Systems or devices must be asbestos-free.
2. Additional requirements: Withstand the passage of cold smoke either as an inherent property of the system, or by the use of a separate product included as a part of the UL system or device, and designed to perform this function.

C. Construction Joint/Gap Firestop Systems:

1. Fill materials listed in the UL Fire Resistance Directory under category XHHW may be used, providing materials conform to the construction type and fire rating involved in each application.
 2. Forming materials listed in the UL Fire Resistance Directory under category XHKU may be used, providing material conforms to the construction type and fire rating involved in each application and meets UL 2079 and ASTM E1966.
 3. Additional requirements: Withstand the passage of cold smoke either as an inherent property of the system, or by the use of a separate product included as a part of the UL system or device, and designed to perform this function.
- D. Firestop Systems for Cable Trays, Conduits, and Cables.
1. Electrical Systems protection material as listed in UL-classified systems UL 1709, ASTM E119, ASTM E1529 and ASTM E1725.
 2. Acceptable products: As listed in the UL Fire Resistance Directory for the applicable UL system.
 - a. Fire resistive mats: 3M Interam Endothermic Mats, 0.3” or 0.4” thick foil encapsulated roll product.
 - b. Smoke and Flame Sealant: 3M FireDam 150 Caulk.
 - c. Foil Tape: 3M Interam T-49 Aluminum Foil Tape; used as a vapor barrier, radiant heat reflector, and installation aid.
 - d. General Purpose Tape: Scotch 898 Filament Tape; used as installation aid.
 - e. Composite Sheet: 3M Fire Barrier CS-195+ Composite Sheet; used to cover openings and as a collar at the termination of the fire protection envelopes.
- E. Firestopping Caulk: 3M Fire Barrier CP 25WB+ Caulk; used as a smoke and flame sealant, Or approved equal

PART 3 - EXECUTION

3.1 PIPING SYSTEMS – COMMON REQUIREMENTS

- 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 Coordination Drawings.
1. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
 2. 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.
 3. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and to allow application of insulation
 4. Install piping to permit valve servicing.
 5. Install piping at indicated slopes and free of sags and bends.
 6. Install fittings for changes in direction and branch connections.
- B. Select system components with pressure rating equal to or greater than system operating pressure.
- C. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
1. New Piping:

- a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
 - f. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
 - g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
 - h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- D. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- E. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Pipe Sleeves: For pipes smaller than NPS 6
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1). Seal space outside of sleeve fittings with grout.
 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- F. Aboveground, Exterior-Wall Pipe Penetrations:
1. Seal penetrations using sleeves and mechanical sleeve seals.
 2. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 3. Install steel pipe for sleeves smaller than 6 inches in diameter.
 4. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 5. 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.
- G. Underground, Exterior-Wall Pipe Penetrations:

1. Install cast-iron "wall pipes" for sleeves.
2. Seal pipe penetrations using mechanical sleeve seals.
3. 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:

1. Select type and number of sealing elements required for pipe material and size.
2. Position pipe in center of sleeve.
3. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve.
4. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

I. Fire-Barrier Penetrations:

1. Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations.
2. Seal pipe penetrations with firestop materials.

J. Verify final equipment locations for roughing-in.

K. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

L. Install piping so as not to encroach on required clearances above or around electrical panels.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints:

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 ID.
4. Join pipe fittings and valves as follows:
5. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
6. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints:

1. Select appropriate gasket material, size, type, and thickness for service application.
2. Install gasket concentrically positioned.
3. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 PAINTING

- A. Painting of systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- C. Paint and finish all electrical equipment and material which is not provided with a factory applied finish, as follows:
1. Where exposed within Mechanical and Electrical Equipment Rooms or similar spaces.
 2. Where exposed outdoors or above the roof.
 3. Where exposed within finished areas of the building, unless otherwise indicated to be painted by the General Contractor.
- D. No equipment or raceways shall be painted before testing and approval.
- E. All surfaces shall be thoroughly cleaned, including galvanized or rusted surfaces, by wire brushing and cleaning or otherwise prepped as recommended by the manufacturer, before finish painting.
- F. Polished chrome plated surfaces shall be cleaned. Replacement will be required if surfaces have been damaged during installation.
- G. All painting shall be performed neatly and in accordance with best practice of the trade.
- H. Where factory finished units are installed, obtain approval of finish color before units are shipped.
- I. Painting generally shall be as follows:
1. Exposed Work:

- a. One prime coat and two finished coats on non-galvanized piping, ducts, control panels or cabinets, equipment, specialties, access doors, manhole frames, covers, ladders, hangers and other ferrous metal work which is not galvanized.
 - b. Galvanized surfaces need not be painted.
2. Concealed Work:
- a. Concealed pipes, ducts, hangers, and supports need not be painted.
 - b. The visible interior portions of all ducts and other enclosures shall be painted with two coats of flat black paint.
3. For all equipment furnished with factory applied primer, apply two finish coats after installation and tests. For equipment furnished with manufacturer's standard finish, field finish coats will be waived if such finish is approved after installation, cleaning, and touching-up.

3.5 EQUIPMENT INSTALLATION – COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope

3.6 ANCHORS

- A. Direct all piping motion to expansion joints by heavy clamps and/or structural steel sections clamped or welded to structural members as required and/or as indicated. Points at which anchors are located and secured shall be approved by the Architect/Engineer such that no structural members shall be unduly strained. Where possible, anchor points shall be on members running parallel to the piping being anchored

3.7 GROUTING

- A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout. Place grout, completely filling equipment bases. Place grout on concrete bases and provide smooth bearing surface for equipment. Place grout around anchors.
- E. Cure placed grout

3.8 ERECTION OF SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor materials and equipment.
- C. Field Welding: Comply with AWS D1.1.
- D. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor materials and equipment.
- E. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- F. Attach to substrates as required to support applied loads.

3.9 FIRESTOP SYSTEMS

- A. Examination:
 - 1. Examine areas and conditions under which firestop system is to be installed and notify the architect of conditions detrimental to proper or timely completion of the work.
 - 2. Examine substrates to determine they are satisfactory to receive firestop system materials.
 - a. Conduct tests according to firestop systems manufacturer's written recommendations to verify that substrates are free of oil, grease, rolling compounds, incompatible primers, loose mill scale, dirt or other foreign substances capable of impairing bond of fire-resistive materials.
 - b. Verify objects penetrating firestop materials, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
 - c. Verify substrates are not obstructed by ducts, piping, equipment, and other suspended construction that will interfere with applying fire-resistive materials.
 - 3. Verify that environmental conditions are safe and suitable for installation of firestop materials.
 - 4. Do not proceed with installation of firestop system until unsatisfactory conditions have been corrected by the contractor in a manner acceptable to the Architect.
- B. Preparation:
 - 1. Clean and repair substrates that could impair the adhesion or proper fitting of firestop materials, including oil, grease, rolling compounds, incompatible primers, and loose mill scale.
 - 2. Secure all pipe, conduit, cable and other items which penetrate firestop materials.
 - 3. Provide masking and temporary covering, as required, to prevent contamination of adjacent surfaces by firestop materials.
- C. Installation – General
 - 1. Installation of firestop systems shall be performed in strict accordance with manufacturer's detailed installation instructions and procedures.
 - 2. Extend firestop material in full thickness over entire area of each substrate or opening to be protected.

3. Protect firestop material from damage on surfaces subject to traffic.

D. Installation of Through–Penetration Firestop Systems

1. General

- a. Install through–penetration firestop systems to comply with firestop systems manufacturer’s written installation instructions and published drawings for products and applications indicated.
- b. Install forming/damming/backing materials and other accessories of types required to support fill material during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1.) After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop system.
- c. Install fill materials for firestop systems by proven techniques to produce the following results.
 - 1.) Fill voids and cavities formed by openings, forming materials, accessories and penetrating items as required too achieve fire-resistance ratings indicated.
 - 2.) Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3.) For fill materials that will remain exposed after completing work, finish to produce smooth, uniform surfaces that are flush with adjoining surfaces.

2. Field Quality Control

- a. Proceed with enclosing through-penetration firestop systems with other construction only after inspection and approval by code authorities.
- b. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.
- c. Inspection Agency: If required, owner will engage a qualified independent inspecting agency to inspect through-penetration firestop systems and to prepare test reports indicating whether through-penetration firestop systems comply with or deviate from requirements.

3. Identification

- a. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:
 - 1.) The words: “Warning-Through-Penetration Firestop System-Do Not Disturb. Notify Building Management of Any Damage”.
 - 2.) Contractor’s name, address and phone number.
 - 3.) Through-penetration firestop systems designation of applicable testing and inspecting agency.
 - 4.) Date of installation.
 - 5.) Through-penetration firestop system manufacturer’s name.
 - 6.) Installer’s name.

4. Cleaning and Protection

- a. Clean off excess fill materials adjacent to openings as work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop systems manufacturer and that do not damage materials in which openings occur.
- b. Provide Final protection and maintain conditions during and after installation that ensure through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce through-penetration firestop systems complying with specified requirements.

3.10 PAINTING AND FINISHING

- A. Painting of systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting".
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- C. Paint and finish all mechanical equipment and material which is not provided with a factory applied finish, as follows:
 1. Where exposed within Mechanical and Electrical Equipment Rooms or similar spaces.
 2. Where exposed outdoors or above the roof.
 3. Where exposed within finished areas of the building, unless otherwise indicated to be painted by the General Contractor.
- D. No piping or ductwork shall be painted before testing and approval.
- E. All surfaces shall be thoroughly cleaned, including galvanized or rusted surfaces, by wire brushing and cleaning or otherwise prepped as recommended by the manufacturer, before finish painting.
- F. All painting shall be performed neatly and in accordance with best practice of the trade.
- G. Where factory finished units are installed, obtain approval of finish color before units are shipped.
- H. Painting generally shall be as follows:
 1. Exposed Work:
 - a. One prime coat and two finished coats on non-galvanized piping, ducts, equipment, specialties, access doors, manhole frames, covers, ladders, supports, hangers and other ferrous metal work which is not galvanized.
 - b. Galvanized surfaces need not be painted.
 2. Concealed Work:
 - a. Concealed ducts, pipes, equipment, hangers, and supports need not be painted.
 3. For all equipment furnished with factory applied primer, apply two finish coats after installation and tests. For equipment furnished with manufacturer's standard finish, field finish coats will be waived if such finish is approved after installation, cleaning, and touching-up.

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4. Painting or protective coating for selected items is specified further in individual Sections.

END OF SECTION 230050

SECTION 230519 - METERS AND GAUGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Thermometers.
 - 2. Gauges.
 - 3. Test plugs.

1.3 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated; include performance curves.
- B. Shop Drawings: Schedule for thermometers and gauges indicating manufacturer's number, scale range, and location for each.
- C. Product Certificates: For each type of thermometer and gauge, signed by product manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
 - 1. Ernst Gauge Co.
 - 2. Eugene Ernst Products Co.
 - 3. Marsh Bellofram.
 - 4. Miljoco Corp.
 - 5. Palmer - Wahl Instruments Inc.
 - 6. Trerice, H. O. Co.
 - 7. Weiss Instruments, Inc.
 - 8. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
 - 9. Winters Instruments.

10. Or approved equal

2.2 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

- A. Case: Die-cast aluminum or brass, 7 or 9 inches long.
- B. Tube: Red reading, organic-liquid filled, with magnifying lens.
- C. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- D. Window: Plastic
- E. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device
- F. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.
- G. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.
- H. Acceptable product: www.miljoco.com Model No. SX7 (7") or SX9 (9"), Trerice BX9, Or approved equal.

2.3 THERMOWELLS

- A. Manufacturers: Same as manufacturer of thermometer being used.
- B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.
- C. Acceptable product: www.miljoco.com Model No. W35B (3½" Stem), W62B (6" Stem for insulation), Or approved equal.

2.4 PRESSURE GAUGES

- A. Direct-Mounting, Dial-Type Pressure Gauges: Indicating-dial type complying with ASME B40.100.
 - 1. Case: Liquid and Dry type, stainless steel, 4-1/2-inch diameter.
 - 2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
 - 3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type.
 - 4. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
 - 6. Pointer: Black metal.
 - 7. Window: Acrylic.
 - 8. Ring: Stainless steel
 - 9. Accuracy: Grade 1A, plus or minus 1 percent of full scale.
 - 10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
 - 11. Range for Fluids under Pressure: Two times operating pressure.
- B. Acceptable product: www.miljoco.com Model No. P4598L or PLF4098L, or Trerice 500XB, Or approved equal

C. Pressure-Gauge Fittings:

1. Valves: NPS 1/4 brass or stainless-steel needle type. Model 1100
2. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure. Model 1200

2.5 TEST PLUGS

- A. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.
- B. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- C. Core Inserts: One or two self-sealing rubber valves.
 1. Insert material for water service at 20 to 200 deg F shall be CR.
 2. Insert material for water service at minus 30 to plus 275 deg F shall be EPDM.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

- A. Install liquid-in-glass thermometers in the following locations:
 1. Inlet and outlet of each hydronic boiler

3.2 GAUGE APPLICATIONS

- A. Install dry-case-type pressure gauges for discharge of each pressure-reducing valve.
- B. Install liquid case-type pressure gauges at each pump. Utilize one gauges with valved tubing to both sides of the pump.

3.3 TEST PORTS

- A. Install test ports at the following locations:
 1. Inlet and outlet of each hydronic boiler
 2. Inlet and outlet of each pump

3.4 INSTALLATIONS

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.

- C. Install direct-mounting pressure gauges in piping tees with pressure gauge located on pipe at most readable position.
- D. Install needle-valve and snubber fitting in piping for each pressure gauge.
- E. Install test plugs in tees in piping.
- F. Install connection fittings for attachment to portable indicators in accessible locations.
- G. Install thermometers and gauges adjacent to machines and equipment to allow service and maintenance for thermometers, gauges, machines, and equipment.
- H. Adjust faces of thermometers and gauges to proper angle for best visibility.

END OF SECTION 230519

SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Bronze ball valves.
- 2. Iron ball valves.
- 3. Bronze lift check valves.
- 4. Bronze swing check valves.
- 5. Balancing Valves.

- B. Related Sections:

- 1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
- 2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
 - 1. Grooved end valves shall be of the same manufacturer as the adjoining couplings.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.9 for building services piping valves.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooved ends, and weld ends.
 - 3. Set valves closed to prevent rattling.
 - 4. Set ball valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
 - 1. Hammond Valve.
 - 2. Milwaukee Valve Company.
 - 3. NIBCO INC.
 - 4. Stockham
 - 5. Victaulic Company
 - 6. Nutech
 - 7. Or approved equal

2.2 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to HVAC valve schedule articles for applications of valves.

- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures. Valves used as the primary shutoff at boilers or pressure vessels shall have the same or higher temperature and pressure ratings than the device they serve.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Handwheel: For valves other than quarter-turn types.
- E. Valve-End Connections:
 - 1. Solder Joint: With sockets according to ASME B16.18. (Soldering and brazing methods used to achieve required pressure-temperature ratings shall not damage internal valve parts. Use solder with melting point below 840 deg F check valves and below 421 deg F for ball valves.)
 - 2. Threaded: With threads according to ASME B1.20.1.
- F. Valve Bypass and Drain Connections: MSS SP-45.

2.3 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
 - 1. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig
 - c. CWP Rating: 600 psig
 - d. Body Design: Two piece.
 - e. Body Material: Bronze (NSF 61 UL Compliant)
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full (no exceptions)
 - 2. Acceptable Full Port Valves: Milwaukee Valve BA400 / BA450, NIBCO T585-70 (threaded); S585-70 (solder) Stockham T285-BR-R-70 (threaded) S285-BR-R-70S585-70 (solder) or the Victaulic Series P589 (Vic-Press ends).

2.4 BRONZE LIFT CHECK VALVES

- A. Class 125, Lift Check Valves with Bronze Disc:
 - 1. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze. (NSF 61 Compliant)
 - e. Ends: Threaded.
 - f. Disc: Bronze (metal) Buna-N NBR, PTFE, or TFE. (non-metal)

2. Acceptable Valves: Milwaukee Valve 548T or 1548T, Nibco S-480 or T-480

2.5 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves

1. Description:

- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 200 psig
- c. Body Design: T pattern
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded or soldered.
- f. Disc: Bronze (metal) Disc: NBR, PTFE, or TFE. (non-metal)

2. Acceptable Valves: Milwaukee Valve 509 or 1509, Nibco S-433 or T-433, Stockham B-316Y

2.6 BALANCING VALVES

- ### A. Note: Hydronic control valves to be pressure independent with integral balancing capability. Balancing valves below are in case there is an application without a control valve.

- ### B. Automatic Flow Control Valves: Class 150, cast iron housing, stainless steel operating parts; threaded connections for 2 inch and smaller, grooved connections for 2-1/2 inch and larger. Factory set to automatically control flow rates within plus or minus 5 percent design, while compensating for system operating pressure differential. Provide quick disconnect valves for flow measuring equipment. Provide a metal identification tag with chain for each valve, factory marked with the zone identification, valve model number, and rate flow in GPM.

Design:

1. Manufacturers: (autoflow balancing valves)

- a. Griswold
- b. Hayes Fluid Controls
- c. Autoflow
- d. FDI (Flow Design Inc)
- e. Victaulic Company
- f. Or approved equal

2. The GPM for the automatic flow control valves shall be factory set and shall automatically limit the rate of flow to within 5% of the specified amount.
3. For 1/2" - 2", the flow cartridge shall be removable from the Y-body housing without the use of special tools to provide access for regulator changeout, inspection and cleaning without breaking the main piping. (Access shall be similar to that provided for removal of a Y-breaking the main piping. (Access shall be similar to that provided for removal of a Y-strainer screen).
4. True operating ranges of 2 - 32 psig or 5 - 60 psig are required. The design flow should be achieved at the minimum psi differential. A 50% safety factor applied to the lower operating range is not acceptable.
5. Each valve shall have two P/T ports.
6. All automatic flow control devices shall be supplied by a single source and certified flow tests, witnessed by a professional engineer, shall be available.

7. Five year product warranty and free first year cartridge exchange.

Construction:

1. The internal wear surfaces of the valve cartridge must be electroless nickel or stainless steel.
2. The internal flow cartridge body shall have machine threads so the spring free height may be compensated for without the use of fixed shims. A crimped sheet metal design is not acceptable.
3. The internal flow cartridge shall be permanently marked with the GPM and spring range.
4. For ½” through 2” pipe sizes: An assembly shall consist of a brass Y-type body, integral brass body ball valve and ‘O’ ring type union; Flow Design Model AC or equal.
5. for 2-1/2” and larger flanged connections: Ductile iron body suitable for mounting wafer style between standard 150# or 300# flanges. The long flange bolts and nuts shall be provided with each control valve. Flow Design Model WS or equal.
6. All valves shall be factory leak tested at 100 psi air under water.

Minimum ratings:

1. ½” through 2” pipe size: 400 PSIG at 250°F.
2. 2-1/2” through 14” pipe size: 600 PSIG at 250°F.
3. 16” through 30” pipe size: 250 PSIG at 250°F.

Flow Verification:

1. Where indicated on the plans, the differential pressure across the Automatic Flow Control Valve shall be measured for flow verification and to determine the amount of system over heading or under pumping.
2. The flow shall be verified by measuring the differential pressure across the coil served or the wide-open temperature control valve and calculating the flow using the coil or valve Cv.

Test Kit:

1. A differential pressure test kit shall be supplied to verify flow and measure overheading.
2. The kit shall consist of a 4-1/2” diaphragm gauge equipped with ten foot hoses and P/T adapters all housed in a vinyl case.
3. Calibration shall be 0 - 35 PSID for 2-32 PSI spring range or 0 - 65 PSID for 5 - 60 PSI range.

Installation:

1. Install automatic flow control valves on the return lines of coils as indicated on the plans. Balancing valve on supply side is not acceptable.
2. The standard ports and handles shall clear 1” thick insulation. Handle and port extensions are required for over 1” thick insulation.
3. Install, on the supply side of coils, a Y-strainer with a brass blowdown valve with ¾” hose end connection with cap and 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 valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Unions and flanges for servicing and disconnect are not required in installations with grooved mechanical joint couplings. (The couplings shall serve as disconnect points.)
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full stem movement.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball or butterfly,
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. Balancing Valves: Autoflow type (coordinate with ATC as some control valves are PICCV type. Provide for all baseboard, cabinet heaters, and HW duct coils using three-way valves.)
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends or solder-joint.

2. For Copper Tubing, NPS 2-1/2 to NPS 6: Flanged or grooved ends.
3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged or grooved ends.

3.5 HEATING WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends. Full port.
2. Bronze Swing Check Valves: Class 125 bronze or nonmetallic disc.

B. Valves used as the primary shutoff at boilers or pressure vessels shall have the same or higher temperature and pressure ratings than the device they serve.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following hangers and supports for plumbing system piping and equipment:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Pipe stands.
 - 7. Equipment supports.
- B. Related Sections include the following:
 - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-protection piping.
 - 3. Division 23 Section(s) "Metal and Nonmetal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Powder-actuated fastener systems.
 - 3. Pipe positioning systems.

- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
 - 2. Metal framing systems. Include Product Data for components.
 - 3. Fiberglass strut systems. Include Product Data for components.
 - 4. Pipe stands. Include Product Data for components.
 - 5. Equipment supports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - 1. National Pipe Hanger Corporation.
 - 2. B-Line Systems, Inc.; a division of Cooper Industries.
 - 3. Carpenter & Paterson, Inc.
 - 4. Empire Industries, Inc.
 - 5. ERICO/Michigan Hanger Co.
 - 6. Grinnell Corp.
 - 7. MIRO Industries
 - 8. Pipe Shields, Inc.
 - 9. Or approved equal

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Galvanized, Metallic Coatings: Pre-galvanized or hot dipped. All metal to be galvanized.
- C. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Coatings: Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

2.5 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.
 - 1. Manufacturers:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
 - c. Masterset Fastening Systems, Inc.
 - d. MKT Fastening, LLC.
 - e. Powers Fasteners.
 - f. Or approved equal
- B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Powers Fasteners.
 - g. Or approved equal

2.6 PIPE STAND FABRICATION

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Low-Type, Single-Pipe Stand: One-piece UV resistant polycarbonate resin base unit with integral slot for pipe, for roof installation without membrane penetration.
 - 1. MIRO Industries: Model 1.5
 - 2. Empire
 - 3. National Pipe Hanger
 - 4. Or approved equal
- C. Low-Type, Single-Pipe Stand: One-piece UV resistant polycarbonate resin base unit with plastic roller, for roof installation without membrane penetration.
 - 1. MIRO Industries: Model 4-RAH

2. Empire
3. National Pipe Hanger
4. Or approved equal

2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT PROJECT SPECIFIC REQUIREMENTS

- A. Refer to individual piping specifications for specific requirements of the type of hangers and supports to utilize.

3.2 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Adjustable, Galvanized Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 2. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4 to allow off-center closure for hanger installation before pipe erection.
 3. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 4. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.

5. 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.
 6. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
 7. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
 8. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
- F. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- G. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- H. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

- I. 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.
- J. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- K. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- L. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- M. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.3 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. 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.
- F. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.
- G. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.
- H. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. 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.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- M. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- O. Insulated Piping: Comply with the following:
1. Attaching clamps and spacers to piping and insulation.
 - 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. Maintain continuous insulation and vapor barrier.
 - c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 4. Shield Dimensions for Pipe: Not less than the following:

- a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.

3.4 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.5 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.6 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.

3.7 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.8 SEISMIC SUPPORT

- A. In structures designed to meet specific seismic events, all mechanical components shall be supported by methods recognized to not interfere with the necessary movement of a structure. All supports shall be designed to accommodate lateral force levels of a seismic event. All conditions shall meet the seismic support requirements of the applicable building code. Refer to specific specification relating to seismic restraint system. Seismic restraints are not required on:
 - 1. Piping suspended by individual hangers twelve inches or less in length from top of pipe to supporting structure.
 - 2. Ducts which have a cross sectional area less than six square feet.
 - 3. Piping in mechanical rooms less than 1-1/4".
 - 4. Piping in building less than 2-1/2".

END OF SECTION 230529

SECTION 230553 - IDENTIFICATION FOR MECHANICAL PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes mechanical identification materials and devices.

1.3 SUBMITTALS

- A. Product Data: For identification materials and devices.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.

1.4 QUALITY ASSURANCE

- A. Comply with ASME A13.1, "Scheme for the Identification of Piping Systems" for lettering size, length of color field, colors, and viewing angles of identification devices.

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.

PART 2 - PRODUCTS

2.1 IDENTIFYING DEVICES AND LABELS

- A. General: Products specified are for applications referenced in other Division 23 Sections. If more than a single type is specified for listed applications, selection is Installer's option. Subject to compliance with requirements, manufacturers offering mechanical identification materials which may be incorporated in the work include but not limited to, the following:

1. Seton Name Plate Co. 800-243-6624
2. National Marker Co. 800-453-2727

3. Marking Services, Inc. 800-234-0135
 4. Or approved equal
- B. Snap-On Plastic Pipe Markers: Manufacturers standard preprinted, semi-rigid, snap-on type. Include color-coding according to ASME A13.1, unless otherwise indicated.
1. Acceptable Product: www.seton.com Seton Identification Products “Set Mark”.
- C. Pressure-Sensitive Pipe Markers: Manufacturers standard preprinted, color coded, pressure-sensitive, vinyl type with permanent adhesive.
1. Acceptable Product: www.seton.com Seton Identification Products “Opti-Code”.
- D. Pipes with OD, Including Insulation, Less than 6 inches: Full-band pipe markers, extending 360 degrees around pipe at each location.
- E. Pipes with OD, Including Insulation, 6 inches and larger: Either full-band or strip-type pipe markers, at least 3 times letter height and of length required for label.
- F. Lettering: Manufacturer’s standard preprinted captions as selected by Engineer.
1. 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.
- G. Plastic Duct Markers: Manufacturer’s standard laminated plastic, in the following color codes:
1. Green: Cold-air supply.
 2. Yellow: Hot-air supply.
 3. Blue: Exhaust, outside, return, and mixed air.
 4. Terminology: Include direction of airflow; duct service such as supply, return, and exhaust; duct origin, duct destination, and design airflow.
- Acceptable Product: www.seton.com Seton Identification Products “Seton Code Markers - Duct”.
- H. Plastic Tape: Manufacturer’s standard color-coded, pressure sensitive, self-adhesive, vinyl tape, at least 3 mils thick.
1. Width: 1-1/2 inches on pipes with OD, including insulation, less than 6 inches; 2-1/2 inches for larger pipes.
 2. Color: Comply with ASME A13.1, unless otherwise indicated
- Acceptable Product: www.seton.com Seton Identification Products “Marking Tape”.

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 LABELING AND IDENTIFYING PIPING SYSTEMS

- A. Install pipe markers on each system. Include arrows showing normal direction of flow. This shall include all new and existing piping.
- B. Marker Type: Plastic markers, with application systems. Install on pipe insulation segment where required for hot, non-insulated pipes.
- C. Fasten markers on pipes and insulated pipes smaller than 6 inches OD by one of the 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 a minimum of 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
- D. Fasten markers on pipes and insulated pipes 6 inches in diameter and larger 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 a minimum of 3 inches 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 or plastic cable ties.
- E. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior non-concealed locations according to the following:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.
 - 3. Near penetrations through walls, floors, ceilings, or non-accessible 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. Spaces at a maximum of 50-foot intervals along each run. Reduce intervals to 25 feet in area of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

3.3 ADJUSTING AND CLEANING

- A. Relocate mechanical identification materials and devices that have become visually blocked by work of this or other Divisions.
- B. Clean faces of identification devices.

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. This Section includes TAB to produce design objectives for the following:
 - 1. Air Systems:
 - a. Constant volume systems
 - 2. Hydronic Piping Systems:
 - a. Constant-flow systems.
 - 3. HVAC equipment quantitative-performance settings.
 - 4. Verifying that automatic control devices are functioning properly.
 - 5. Reporting results of activities and procedures specified in this Section.

1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
- C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- E. NC: Noise criteria.
- F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- G. RC: Room criteria.
- H. Report Forms: Test data sheets for recording test data in logical order.
- I. Smoke-Control System: An engineered system that uses fans to produce airflow and pressure differences across barriers to limit smoke movement.

- J. Smoke-Control Zone: A space within a building that is enclosed by smoke barriers and is a part of a zoned smoke-control system.
- K. Stair Pressurization System: A type of smoke-control system that is intended to positively pressurize stair towers with outdoor air by using fans to keep smoke from contaminating the stair towers during an alarm condition.
- L. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- M. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- N. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- O. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- P. TAB: Testing, adjusting, and balancing.
- Q. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- R. Test: A procedure to determine quantitative performance of systems or equipment.
- S. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 SUBMITTALS

- A. Qualification Data: Within 45 days from Contractor's Notice to Proceed, submit 4 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 45 days from Contractor's Notice to Proceed, submit 4 copies of the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 90 days from Contractor's Notice to Proceed, submit 4 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- D. Certified TAB Reports: Submit three copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

1.5 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by AABC, NEBB, or TABB.
- B. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives; HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:
 - a. Submittal distribution requirements.
 - b. The Contract Documents examination report.
 - c. TAB plan.
 - d. Work schedule and Project-site access requirements.
 - e. Coordination and cooperation of trades and subcontractors.
 - f. Coordination of documentation and communication flow.

- C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

- D. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems". NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems".

- E. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification".

- F. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
 1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

- 1.6 PROJECT CONDITIONS
 - A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

- 1.7 COORDINATION
 - A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
 - B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
 - C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

- A. National Project Performance Guarantee: Provide a guarantee on AABC's, NEBB or TABB forms stating that AABC, NEBB or TABB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
1. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine Project Record Documents described in Division 01 Section "Project Record Documents."
- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data including fan and pump curves. 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. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- G. Examine system and equipment test reports.
- H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

- J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
- L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- M. Examine strainers for clean screens and proper perforations.
- N. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- O. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- P. Examine system pumps to ensure absence of entrained air in the suction piping.
- Q. Examine equipment for installation and for properly operating safety interlocks and controls.
- R. 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 system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems", NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA's TABB "HVAC Systems - Testing, Adjusting, and Balancing"] and this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

- C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- D. Take and report testing and balancing measurements in inch-pound 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 outside-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. Check for proper sealing of air duct system.

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. If design airflow can not be obtained with the installed sheaves and belts they shall be replaced with a set that will allow proper speed adjustments.
 - 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable 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 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.
 - 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

- a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
 4. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, sub-main ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 - a. Where sufficient space in sub-main 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. Re-measure each sub-main and branch duct after all have been adjusted. Continue to adjust sub-main and branch ducts to indicated airflows within specified tolerances.
- C. Measure terminal 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 terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 1. Open all manual valves for maximum flow.
 2. Check expansion tank liquid level.
 3. Check makeup-water-station pressure gage for adequate pressure for highest vent.

4. Check flow-control valves for specified sequence of operation and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.7 PROCEDURES FOR HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:
 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 4. Report flow rates that are not within plus or minus 5 percent of design.
- B. Set calibrated balancing valves, if installed, at calculated presettings.
- C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 1. Determine the balancing station with the highest percentage over indicated flow.
 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 3. Record settings and mark balancing devices.
- F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.8 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Water Coils: Measure the following data for each coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Refrigerant Coils: Measure the following data for each 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.

3.9 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a pre-construction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the refrigerant charge.
4. Check the condition of filters.
5. Check the condition of coils.
6. Check the operation of the drain pan and condensate drain trap.
7. Check bearings and other lubricated parts for proper lubrication.
8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished.

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan, speed, filter, and coil face velocity.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the airflow and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated airflow and water flow rates. If 5 percent or less, equipment adjustments are not required.
4. Air balance each air outlet.

3.10 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
 - 2. Air Outlets and Inlets: 0 to minus 10 percent.
 - 3. Heating-Water Flow Rate: 0 to minus 10 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: As Work progresses, prepare 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: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 - 1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
 - 1. Title page.
 - 2. Name and address of TAB firm.
 - 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 firm 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, type size, and fittings.
 14. Notes to explain why certain final data in the body of reports varies from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outside-, 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.
- E. 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 outside, 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.
- F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data: Include the following:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Sheave dimensions, center-to-center, and amount of adjustments in inches (mm).
 - j. Number of belts, make, and size.
 - k. Number of filters, type, and size.
 2. Motor Data:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.

- d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Sheave dimensions, center-to-center, and amount of adjustments in inches (mm).
3. Test Data (Indicated and Actual Values):
- a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg .
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Filter static-pressure differential in inches wg.
 - f. Preheat coil static-pressure differential in inches wg.
 - g. Cooling coil static-pressure differential in inches wg.
 - h. Heating coil static-pressure differential in inches wg.
 - i. Outside airflow in cfm.
 - j. Return airflow in cfm.
 - k. Outside-air damper position.
 - l. Return-air damper position.
 - m. Vortex damper position.
- G. Apparatus-Coil Test Reports:
1. Coil Data:
 - a. System identification.
 - b. Location.
 - c. Coil type.
 - d. Number of rows.
 - e. Fin spacing in fins per inch o.c.
 - f. Make and model number.
 - g. Face area in sq. ft.
 - h. Tube size in NPS.
 - i. Tube and fin materials.
 - j. Circuiting arrangement.
 2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm.
 - b. Average face velocity in fpm.
 - c. Air pressure drop in inches wg.
 - d. Outside-air, wet- and dry-bulb temperatures in deg F.
 - e. Return-air, wet- and dry-bulb temperatures in deg F.
 - f. Entering-air, wet- and dry-bulb temperatures in deg F.
 - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
 - h. Water flow rate in gpm.
 - i. Water pressure differential in feet of head or psig.
 - j. Entering-water temperature in deg F.
 - k. Leaving-water temperature in deg F.
 - l. Refrigerant expansion valve and refrigerant types.
 - m. Refrigerant suction pressure in psig.
 - n. Refrigerant suction temperature in deg F.
 - o. Inlet steam pressure in psig.
- H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Sheave dimensions, center-to-center, and amount of adjustments in inches.

2. Motor Data:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - g. Number of belts, make, and size.

3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.

- I. Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
 1. Report Data:
 - a. System and air-handling unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in sq. ft.
 - g. Indicated airflow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual airflow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.

- J. Air-Terminal-Device Reports:
 1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Test apparatus used.
 - d. Area served.

- e. Air-terminal-device make.
 - f. Air-terminal-device number from system diagram.
 - g. Air-terminal-device type and model number.
 - h. Air-terminal-device size.
 - i. Air-terminal-device effective area in sq. ft.
 2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary airflow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final airflow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.
- K. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
 1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 - e. Flowmeter type.
 2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm.
 - b. Entering-water temperature in deg F.
 - c. Leaving-water temperature in deg F.
 - d. Water pressure drop in feet of head or psig.
 - e. Entering-air temperature in deg F.
 - f. Leaving-air temperature in deg F.
- L. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model and serial numbers.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig.
 - h. Required net positive suction head in feet of head or psig.
 - i. Pump rpm.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.

- o. Full-load amperage and service factor.
 - p. Seal type.
2. Test Data (Indicated and Actual Values):
- a. Static head in feet of head or psig.
 - b. Pump shutoff pressure in feet of head or psig.
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig.
 - f. Final discharge pressure in feet of head or psig.
 - g. Final suction pressure in feet of head or psig.
 - h. Final total pressure in feet of head or psig.
 - i. Final water flow rate in gpm.
 - j. Voltage at each connection.
 - k. Amperage for each phase.
- M. Instrument Calibration Reports:
1. Report Data:
- a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.
- 3.13 INSPECTIONS
- A. Initial Inspection:
- 1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
 - 2. Randomly check the following for each system:
 - a. Measure airflow of at least 10 percent of air outlets.
 - b. Measure water flow of at least 5 percent of terminals.
 - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - d. Measure sound levels at two locations.
 - e. Measure space pressure of at least 10 percent of locations.
 - f. Verify that balancing devices are marked with final balance position.
 - g. Note deviations to the Contract Documents in the Final Report.
- B. Final Inspection:
- 1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
 - 2. TAB firm test and balance engineer shall conduct the inspection in the presence of Architect.
 - 3. Architect shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.

4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.14 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing 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 testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Insulation Materials:
 - a. Flexible Elastomeric.
 - b. Mineral fiber board and blanket.
- 2. Insulating cements.
- 3. Adhesives.
- 4. Sealants.
- 5. Mastics
- 6. Field-applied jackets.
- 7. Tapes.

- B. Related Sections:

- 1. Division 22 Section "Plumbing Insulation."
- 2. Division 23 Section "Metal [and Nonmetal] Ducts" for duct liners.

- C. Insulate all hot water piping and all supply air ductwork.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

- B. Shop Drawings:

- 1. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
- 2. Detail removable insulation at piping specialties, equipment connections, and access panels.
- 3. Detail application at linkages of control devices.
- 4. Detail field application for each equipment type.

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.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems. 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. General Requirements:
 - 1. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
 - 2. Products shall not contain asbestos, lead, mercury, or mercury compounds.
 - 3. If applicable, 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.
 - 4. If applicable, insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- B. 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 FSP jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide from one of the following:
 - a. CertainTeed Corp

- b. Johns Manville
 - c. Knauf Insulation
 - d. Owens Corning
 - e. Or approved equal
 2. Acceptable Product: www.knaufusa.com Knauf Insulation Model “Duct Wrap”
- C. Mineral-Fiber, Preformed Pipe Insulation:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - e. Or approved equal
 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 3. On cold systems, vapor barrier performance is extremely important. All penetrations of the ASJ and exposed ends of insulation shall be sealed with vapor barrier mastic. If humidities in excess of 90% are expected, the ASJ shall be protected with either a mastic coating or a suitable vapor retarding outer jacket. Vapor seals at butt joints shall be applied at every fourth pipe section joint and at each fitting to provide isolation of water incursion.
 4. Fittings and valves shall be insulated with pre-formed fiberglass fittings, fabricated sections of fiberglass pipe insulation, pipe and tank Insulation, blanket insulation, or insulating cement. Thickness shall be equal to adjacent pipe insulation. Finish shall be with pre-formed PVC fitting covers. PVC shall be rated for 25/50 flame/smoke spread rating. Flanges, couplings and valve bonnets shall be covered with an oversized pipe insulation section sized to provide the same insulation thickness as on the main pipe section. An oversized insulation section shall be used to form a collar between the two insulation sections with low-density blanket insulation being used to fill gaps. Jacketing shall match that used on straight pipe sections. Rough cut ends shall be coated with suitable weather or vapor resistant mastic as dictated by the system location and service. On hot systems where fittings are to be left exposed, insulation ends should be beveled away from bolts for easy access. On cold systems, particular care must be given to vapor sealing the fitting cover or finish to the pipe insulation vapor barrier. All valve stems shall be sealed with caulking to allow free movement of the stem but provide a seal against moisture incursion.
 5. Acceptable Product: www.knaufusa.com Knauf Insulation Model “1000 Pipe Insulation”
- D. Flexible Elastomeric (Piping): Expanded flexible elastomeric closed-cell foam tubular materials with manufactured pre-slit and self-sealing closure system complying with ASTM C 534, type 1, Grade 1.
 1. Products: Subject compliance with requirements, provide from the following or approved equal.
 - a. Armacell LLC
 - b. K-Flex USA
 - c. Rubatex
 - d. Or approved equal
 2. Acceptable Product: www.armacell.com Armacell LLC, Model “SS Self-Seal Pipe Insulation”.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated. Refer to insulation manufacturers specifications for appropriate adhesives to utilize.

2.3 SEALANTS

A. 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.
5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK, ASJ and 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. FSK Jacket Color: Aluminum.
5. ASJ Jacket Color: White.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.

2.4 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.

2.5 SECUREMENTS

- A. Bands:
 - 1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, wide with wing seal.
 - 2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.
- B. Insulation Pins and Hangers:
 - 1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
- C. Wire: 0.080-inch nickel-copper alloy, 0.062-inch soft-annealed, stainless steel, or 0.062-inch soft-annealed, galvanized steel.

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.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, 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.
- B. 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.
- C. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- D. Install multiple layers of insulation with longitudinal and end seams staggered.
- E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, 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.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap.
 - 4. 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.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- O. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. 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".

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, 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.

3.6 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.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 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.

3.7 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.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

3.9 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Inspect ductwork, randomly selected by Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to two locations for each duct system defined in the "Duct Insulation Schedule, General" Article.
 - 2. Inspect field-insulated equipment, randomly selected by Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to two locations for each type of equipment defined in the "Equipment Insulation Schedule" Article. 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 "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 - 1. Indoor, supply and outdoor air.
- B. Items Not Insulated:
 - 1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1-2015. If duct liner does not meet the minimum requirements stipulated with the energy code and ASHRAE/IESNA 90.1-2015, additional exterior insulation shall be provided.
 - 2. Factory-insulated flexible ducts.
 - 3. Factory-insulated plenums and casings.
 - 4. Flexible connectors.
 - 5. Factory-insulated access panels and doors.
 - 6. Nameplates and data plates.
 - 7. Testing agency labels and stamps.

3.12 INDOOR DUCT AND PLENUM APPLICATION SCHEDULE

- A. Service: Supply air ducts on the warm side of the building insulation.
 - 1. Material: Mineral-fiber blanket.
 - 2. Thickness: 1-1/2 inches.
 - 3. Number of Layers: One.
 - 4. Field-Applied Jacket: Foil and paper.
 - 5. Vapor Retarder Required: Yes.
- B. Service: Outside-air ducts the warm side of the building insulation

1. Material: Mineral-fiber blanket.
2. Thickness: 2 inches.
3. Number of Layers: One.
4. Field-Applied Jacket: Foil and paper.
5. Vapor Retarder Required: Yes.

C. Service: Exhaust Air and Relief Air ducts between the motorized damper and outside termination point. (concealed).

1. Material: Mineral-fiber blanket.
2. Thickness: 2 inches.
3. Number of Layers: One.
4. Field-Applied Jacket: Foil and paper.
5. Vapor Retarder Required: Yes.

3.13 PIPE INSULATION

A. Field-applied pipe jacket: Apply metal jacket where indicated, 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.

B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:

1. Flexible connectors.
2. Vibration-control devices.
3. Fire-suppression piping.
4. Drainage piping located in crawl spaces, unless otherwise indicated.
5. Below-grade piping, unless otherwise indicated.
6. Chrome-plated pipes and fittings, unless potential for personnel injury.
7. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.

3.14 PIPE INSULATION APPLICATION SCHEDULE

A. Service: Condensate drain piping.

1. Operating Temperature: 35 to 75 deg F.
2. Insulation Material: Flexible elastomeric (piping).
3. Insulation Thickness: 1"
4. Field-Applied Jacket: None.
5. Vapor Retarder Required: Yes.
6. Finish: None.

B. Service: Chilled water supply and return.

1. Operating Temperature: 100 to 200 deg F.
2. Insulation Material: Mineral fiberglass, with jacket.
3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Piping 1-1/2" and less – 1.5" thick
 - b. Piping 2" to 4" – 2" thick

- c. Piping 5” to up” – 2” thick
 4. Field-Applied Jacket: Foil and paper.
 5. Vapor Retarder Required: Yes
 6. Finish: None.
- C. Service: Heating hot-water supply and return.
1. Operating Temperature: 100 to 200 deg F.
 2. Insulation Material: Mineral fiberglass, with jacket.
 3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Piping 1-1/2” and less – 1.5” thick
 - b. Piping 2 ” to 4” – 2” thick
 - c. Piping 5” to up” – 2” thick
 4. Field-Applied Jacket: Foil and paper.
 5. Vapor Retarder Required: No.
 6. Finish: None.
- D. Service: Refrigerant suction and hot-gas piping.
1. Operating Temperature: 35 to 50 deg F.
 2. Insulation Material: Glass Mineral Wool with jacket or Flexible elastomeric (piping).
 3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Piping 2” and less – 1 ½” thick
 - b. Piping 2½ ” to 3” – 2” thick
 - c. Piping 4” to up 6” – 2” thick
 4. Field-Applied Jacket: None.
 5. Vapor Retarder Required: Yes.
 6. Finish: Paint exterior to protect from Sun’s UV light.

END OF SECTION 230700

SECTION 230900 – AUTOMATIC TEMPERATURE CONTROLS

PART 1 - GENERAL

1.1 BIDDING REQUIREMENTS

- A. The Contractor shall be responsible for a complete and operational control system that fully and seamlessly integrates into the existing district-wide Honeywell Enterprise Building Integrator (EBI) and shall bare all costs associated with such work.
 - 1. All new equipment shall be provided from the factory with control terminal stripes in preparation for field-mounted Honeywell ComfortPoint Open BACnet controllers.
- B. The control system shall consist of an extension of the existing Honeywell high-speed, peer-to-peer network of DDC controllers and web-based operator interface. The Contractor shall include in his bid the costs associated with any reprogramming and updating of the front end controls to depict each new mechanical system and building floor plan by a point-and-click graphic.

1.2 SUMMARY

- A. This Section includes control equipment for HVAC systems and components.
- B. The Contractor shall furnish and install all necessary hardware and all operating and applications software necessary to perform the control sequences of operation as called for in this specification. All control work shall be an extension of the existing Honeywell Enterprise Building Integrator (EBI) currently in operation through the District. Items of work, as required, are included as follows:
 - 1. Provide all necessary hardware and software to meet the system's functional specifications. Provide Protocol Implementation Conformance Statement (PICS) for every controller in system, including unitary controllers.
 - 2. Prepare individual hardware layouts, interconnection drawings, and software configuration from project design data. Submit to Engineer prior to commencement of work.
 - 3. Implement the detailed design for all system-standard analog and binary objects, distributed control and system databases, graphic displays, logs, and management reports based on control descriptions, logic drawings, configuration data, and bid documents.
 - 4. Design, provide, and install all equipment cabinets, panels, data communication network cables needed, and all associated hardware.
 - 5. Provide and install all interconnecting cables between all operator terminals and peripheral devices, such as printers, etc., supplied under this section.
 - 6. Provide complete manufacturer's specifications for all items that are supplied. Include vendor name of every item supplied.
 - 7. Provide supervisory specialists and technicians at the job site to assist in all phases of system installation, startup, and commissioning.
 - 8. Provide a comprehensive operator and technician training program.
 - 9. Provide as-built documentation, operator's terminal software, diagrams, and all other associated project operational documentation (such as technical manuals) on approved media, the sum total of which accurately represents the final system including panel and circuit numbers.

1.3 SUBMITTALS

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches and control panels.
 2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
 3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
- 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. Drawings shall be submitted in the following standard sizes: 11" x 17" (ANSI B).
 2. Drawings shall be provided, unlocked, on CD-ROM in CAD .dwg, .vsd, or .pdf formats.
 3. Bill of materials of equipment indicating quantity, manufacturer, and model number.
 4. Schematic flow diagrams showing fans, coils, dampers, valves, and control devices.
 5. Wiring Diagrams: Power, signal, and control wiring.
 6. Details of control panel faces, including controls, instruments, and labeling.
 7. Written description of sequence of operation.
 8. Schedule of dampers including size, leakage, and flow characteristics.
 9. Schedule of valves.
 10. DDC System Hardware:
 - a. Wiring diagrams for control units with termination numbers.
 - b. Schematic diagrams and floor plans for field sensors and control hardware.
 - c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
- C. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
 2. Interconnection wiring diagrams with identified and numbered system components and devices.
 3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
 4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 5. Calibration records and list of set points.

1.4 QUALITY ASSURANCE

- A. General
1. The Building Automation System (BAS) sub-contractor primary business shall regularly engaged in the engineering, programming, installation and service of total integrated Building Management Systems.

- The BAS sub-contractor shall be a recognized national manufacturer, installer and service provider of ATC.
2. The BAS sub-contractor shall have an office facility within a 100 mile radius of the job site supplying complete maintenance and support services on a 24 hour, 7-day-a-week basis.
 3. As evidence and assurance of the contractor's ability to support the Owner's system with service and parts, the contractor must have been in the BAS business for at least the last ten (10) years and have successfully completed total projects of at least 10 times the value of this contract in each of the preceding five years.
 4. The BAS architecture shall consist of the products of a manufacturer regularly engaged in the production of BAS, and shall be the manufacturer's latest standard of design at the time of bid.
 5. All controls, other than relays, transformers and panels shall be the product of the same manufacturer.
 6. The BAS sub-contractor shall be certified by the State of New Jersey; Department of the Treasury, Division of Construction, Trenton, New Jersey.
 - a. Automatic Temperature Control Systems: 8 million dollars.
 - b. Energy Management Systems: 8 million dollars.
 7. A copy of this certification shall be part of the bid and/or submitted prior to awarding of a contract.
 8. Parts Stocking: The BAS sub-contractor shall have an independently verifiable inventory of electronic service parts. This electronic service parts inventory must have a worth of at least \$25,000 per year over each of the last five years.
 9. Past Projects: The BAS sub-contractor shall have completed a minimum of twenty projects within the last five years, which are at least equal in dollar and scope to this project. A list of similar projects, dollar volume, scope, contact name and contact number shall be provided by the BAS sub-contractor if asked for by the owner.
 10. Engineered Drawings: All control drawings shall be generated using Computer Aided Drafting or MS Visio. All project drawings shall be supplied to the owner on an MS-DOS formatted diskette using the DXF file format, .vsd file format or Adobe .PDF format upon project completion. Further additions or changes to the BAS shall be reflected upon the CAD/MS Visio drawings.
 11. Title 52 of N.J.S.A. requires that only domestic materials are to be used on public works contracts. N.J.S.A. 18A:18A-20 which applies to all public schools in the State of New Jersey also requires that American goods and products must be used.

B. Workplace Safety And Hazardous Materials

1. Provide a safety program in compliance with the Contract Documents.
2. The BAS sub-contractor shall have a corporately certified comprehensive Safety Certification Manual and a designated Safety Supervisor for the Project.
3. The Contractor and its employees and subtrades comply with federal, state and local safety regulations.
4. The Contractor shall ensure that all subcontractors and employees have written safety programs in place that covers their scope of work, and that their employees receive the training required by the OSHA have jurisdiction for at least each topic listed in the Safety Certification Manual.
5. The Contractor shall sign and date a safety certification form prior to any work being performed, stating that the Contractors' company is in full compliance with the Project safety requirements.
6. The Contractor's safety program shall include written policy and arrangements for the handling, storage and management of all hazardous materials to be used in the work in compliance with the requirements of the AHJ at the Project site.
7. The Contractor's employees and subcontractor's staff shall have received training as applicable in the use of hazardous materials and shall govern their actions accordingly.

C. Quality Management Program

1. Designate a competent and experienced employee to provide BAS Project Management. The designated Project Manger shall be empowered to make technical, scheduling and related decisions on behalf of the BAS sub-contractor. At minimum, the Project Manager shall:
 - a. Manage the scheduling of the work to ensure that adequate materials, labor and other resources are available as needed.
 - b. Manage the financial aspects of the BAS Contract.
 - c. Coordinate as necessary with other trades.
 - d. Be responsible for the work and actions of the BAS workforce on site.
- D. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.
- E. 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.
- F. Tools, Testing and Calibration Equipment: The control system supplier shall provide all tools, testing, and calibration equipment necessary to ensure reliability and accuracy of the control system.
- G. Bids by wholesalers, dealers or any other firm not authorized by the DDC System manufacturer to design, install and service the specified Direct Digital / Building Management Control Systems shall not be acceptable.

1.5 WARRANTY & SERVICE CONTRACT

- A. A one (1) year service contract shall be included for the project, this service contract shall start at time of system acceptance as a minimum the contract shall provide:
 1. Eight (8) hours of remedial customer training to be scheduled at the mid-point and end of contract.
 2. Four (4) – 8 hour quarterly visits for scheduled calibration and adjustment of controls
 3. A fixed labor rate and parts/material multiplier for project provided controllers and repair components not covered under the warranty.
 4. Warranty shall cover all costs for parts, labor, associated travel, and expenses for a period of one year from completion of system and owner acceptance.
- B. Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner after failure notification to the vendor. The maximum acceptable response time to provide this service at the site shall be 24 hours.
- C. This warranty shall apply equally to both hardware and software.
- D. The warranty period shall include all rescheduling, setpoint changing, and reprogramming from the supplier office via internet connection.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Control Valves: Furnish (3) three spare control valves. Spare control valves shall be of equivalent size to that of UV-1. Turn over to Owner.
 2. Damper Actuators: Furnish (3) three spare damper actuator motors. Turn over to owner.

1.7 OWNERSHIP OF PROPRIETARY MATERIAL

- A. All project-developed software and documentation shall become the property of the owner. These include but are not limited to:
 - 1. Project graphic images and generation software.
 - 2. Record drawings in AutoCAD format and as PDFs.
 - 3. Project database
 - 4. Project-specific application programming code
 - 5. The full suite of programming tools and associated licenses
 - 6. All documentation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Controls shall be by Honeywell ComfortPoint Open BACnet and shall seamlessly interface with the existing BAS.
- B. Substitutions may be permitted by the Engineer or Owner, if, in his opinion, the requirements of the proposed substitution comply with the requirements specified for the material, article or piece of equipment; however, the Engineer or Owner is not required to permit substitution pursuant to the case of Whitten Corporation vs. Paddock, Incorporated, United States District Court, Massachusetts, April 12, 1974, affirmed by the Federal First Circuit Court, December 14, 1974, and the United States Supreme Court, 1988.

2.2 CONTROL SYSTEM

- A. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An existing operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

2.3 DDC EQUIPMENT

- A. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
 - 1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
 - 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 - d. Software applications, scheduling, and alarm processing.

- e. Testing and developing control algorithms without disrupting field hardware and controlled environment.
3. Standard Application Programs:
 - a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.
 - b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
 - c. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
 - d. Custom Reports. Operator shall be able to create custom reports that retrieve data, including archived trend data, from the system, that analyze data using common algebraic calculations, and that present results in tabular or graphical format. Reports shall be launched from the operator interface.
 - e. Remote communications.
 - f. Maintenance management.
 - g. Units of Measure: Inch-pound and SI (metric).
4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
- B. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
 1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
- C. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
 1. Binary Inputs: Allow monitoring of on-off signals without external power.
 2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
 3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
 4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation.
 5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA).
 6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
 7. Universal I/Os: Provide software selectable binary or analog outputs.

- D. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
1. Output ripple of 5.0 mV maximum peak to peak.
 2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
 3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

2.4 BUILDING CONTROLLERS

- A. General. Provide Building Controllers to provide the performance specified in section 1 of this division. Each of these panels shall meet the following requirements.
1. The Building Automation System shall be composed of one or more independent, stand-alone, microprocessor based Building Controllers to manage the global strategies described in System software section.
 2. The Building Controller shall have sufficient memory to support its operating system, database, and programming requirements.
 3. The controller shall provide a communications port for connection of the Portable Operators Terminal using Point to Point BACnet physical/data link layer protocol or a connection to the inter-network.
 4. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
 5. Controllers that perform scheduling shall have a real time clock.
 6. Data shall be shared between networked Building Controllers.
 7. The Building Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
 - a. Assume a predetermined failure mode.
 - b. Generate an alarm notification.
 8. BACnet. The Building Controller shall use the Read (Initiate) and Write (Execute) Services as defined in these BIBBS:
- B. Communications. Each Building Controller shall reside on a BACnet inter-network using the ISO 8802-3 (Ethernet) or ARCNET (ASTM 878.1) Physical/Data Link layer protocol. Each Building Controller shall also perform routing to a network of Custom Application and Application Specific Controllers.] [Optional – Each Building Controller shall perform communications to a network of Custom Application and Application Specific Controllers using LonTalk FTT-10 and LonMark profiles.]
- C. Environment. Controller hardware shall be suitable for the anticipated ambient conditions. Controller used in conditioned ambient shall be mounted in an enclosure, and shall be rated for operation at 0 C to 50 C [32 F to 120 F].
- D. Serviceability. Provide diagnostic LEDs for power, communications, and processor. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable.
- E. Memory. The Building Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.

- F. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shut-down below 80% nominal voltage.

2.5 APPLICATION SPECIFIC CONTROLLERS

- A. General. Application specific controllers (ASC) are microprocessor-based DDC controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. They are not fully user programmable, but are customized for operation within the confines of the equipment they are designed to serve.
 - 1. Each ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network.
 - 2. Each ASC will contain sufficient I/O capacity to control the target system.
- B. Environment. The hardware shall be suitable for the anticipated ambient conditions.
 - 1. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40 C to 65 C [-40 F to 150 F].
 - 2. Controller used in conditioned ambient shall be mounted in NEMA 1 type rated enclosures. Controllers located where not to be disturbed by building activity (such as above ceiling grid), may be provided with plenum-rated enclosures and non-enclosed wiring connections for plenum cabling. All controllers shall be rated for operation at 0 C to 50 C [32 F to 120 F].
- C. Serviceability. Provide diagnostic LEDs for power and communications. All wiring connections shall be clearly labeled and made to be field removable.
- D. Memory. The Application Specific Controller shall maintain all BIOS and programming information in the event of a power loss for at least 90 days.
- E. Immunity to Power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80%.
- F. Transformer. Power supply for the ASC must be rated at minimum of 125% of ASC power consumption, and shall be fused or current limiting type.
- G. Application Specific Controllers shall communicate using the BACnet communications protocol. Application Specific Controllers shall communicate using BACnet.

2.6 COMMUNICATIONS

- A. This project shall comprise a network utilizing BACnet for communications between Building Controllers and PC Workstations.
- B. Each BACnet device shall operate on the BACnet physical/data link protocols specified for that device as defined earlier in this section.
- C. All Building Controllers shall have a communications port for connections with the operator interfaces. This may be either an RS-232 port for Point to Point connection or a network interface node for connection to the Ethernet or ARCNET network.
- D. Remote operator interface via a internet or world wide web shall allow for communication with any and all controllers on this network as described in F below.

- E. Communications services over the internetwork shall result in operator interface and value passing that is transparent to the internetwork architecture as follows:
 - 1. Connection of an operator interface device to any one controller on the internetwork will allow the operator to interface with all other controllers as if that interface were directly connected to the other controllers. Data, status information, reports, system software, custom programs, etc., for all controllers shall be available for viewing and editing from any one controller on the internetwork.
 - 2. All database values (i.e., points, software variable, custom program variables) of any one controller shall be readable by any other controller on the internetwork. This value passing shall be automatically performed by a controller when a reference to a point name not located in that controller is entered into the controller's database. An operator/installer shall not be required to set up any communications services to perform internetwork value passing.
- F. The time clocks in all controllers shall be automatically synchronized daily.

2.7 INPUT / OUTPUT INTERFACE

- A. Hard-wired inputs and outputs may tie into the system through Building, Custom, or Application Specific Controllers.
- B. All input points and output points shall be protected such that shorting of the point to itself, another point, or ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.
- C. Binary inputs shall allow the monitoring of on/off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 ma to be compatible with commonly available control devices.
- D. Pulse accumulation input points. This type of point shall conform to all the requirements of Binary Input points, and also accept up to 2 pulses per second for pulse accumulation, and shall be protected against effects of contact bounce and noise.
- E. Analog inputs shall allow the monitoring of low voltage (0-10 Vdc), current (4-20 ma), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with, and field configurable to commonly available sensing devices.
- F. Binary outputs shall provide for on/off operation, or a pulsed low voltage signal for pulse width modulation control. [Binary outputs on custom and building controllers shall have 3-position (on/off/auto) override switches and status lights.] Outputs shall be selectable for either normally open or normally closed operation.
- G. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0-10 Vdc or a 4-20 ma signal as required to provide proper control of the output device. [Analog outputs on building or custom programmable controllers shall have status lights, a 2-position (auto/manual) switch, and manually adjustable potentiometer for manual override.]

2.8 UNITARY CONTROLLERS

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.

1. Configuration: Local keypad and display on wall temperature sensors; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with EEPROM bios.
2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
3. Enclosure: NEMA 1 rated for operation at 32 to 120 deg F.
4. Enclosure: Waterproof rated for operation at 40 to 150 deg F (if located in wet location)

2.9 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall and/or immersion mounting as required.
- B. Thermistor Temperature Sensors and Transmitters:
 1. Accuracy: Plus or minus 0.5 deg F at calibration point.
 2. Wire: Twisted, shielded-pair cable.
 3. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.

2.10 STATUS SENSORS

- A. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
- B. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

2.11 THERMOSTATS

- A. Thermostats: Line or low voltage thermostat with push-button or lever-operated fan switch.
 1. Mount on single electric switch box. To be rated for amperage and voltage of the controlled device.
- B. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.

2.12 DAMPER ACTUATORS

- A. Electronic Damper Actuators:
 1. Manufactured, brand labeled or distributed by Honeywell.
 2. Size for torque required for damper seal at load conditions.
 3. Coupling: V-bolt dual nut clamp with a V-shaped, toothed cradle
 4. Mounting: Actuators shall be capable of being mechanically and electrically paralleled to increase torque if required.
 5. Overload Protection: Electronic overload or digital rotation-sensing circuitry without the use of end switches to prevent any damage to the actuator during a stall condition.
 6. Fail-Safe Operation: Mechanical, spring-return mechanism.

7. Power Requirements (Spring Return):, 24 or 120 Vac (depending on application), maximum 10 VA at 24-V ac.
8. Proportional Actuators shall be fully programmable. Control input, position feedback and running time shall be factory or field programmable by use of external computer software Diagnostic feedback shall provide indications of hunting or oscillation, mechanical overload and mechanical travel. Programming shall be through an EEPROM without the use of actuator mounted switches.
9. Temperature Rating: -22 to +122°F.
10. Housing: Minimum requirement NEMA type 2 (4/4X) / IP54 (IP67) mounted in any orientation.
11. Agency Listing: ISO 9001, cULus, and CSA C22.2 No. 24-93.
12. The manufacturer shall warrant all components for a period of 5 years from the date of production, with the first two years unconditional.

B. Electronic Valve Actuators:

1. Manufactured, brand labeled or distributed by Honeywell.
2. Size for torque required for valve close off at 150 percent of total system (head) pressure for two-way valves; and 100 percent of pressure differential across the valve or 100 percent of total system (pump) head differential pressure for three-way valves.
3. Coupling: Directly couple end mount to stem, shaft, or ISO-style direct-coupled mounting pad.
4. Mounting: Actuators shall be capable of being mechanically and electrically paralleled to increase torque if required.
5. Overload Protection: Electronic overload or digital rotation-sensing circuitry without the use of end switches to deactivate the actuator at the end of rotation.
6. Fail-Safe Operation: Mechanical, spring-return mechanism. Internal chemical storage systems, capacitors, or other internal non-mechanical forms of fail-safe operation are not acceptable.
7. Power Requirements: Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
8. Maximum 1 VA at 24-V ac or 1 W at 24-V dc.
9. Temperature Rating: -22 to +122°F
10. Housing: Minimum requirement NEMA type 2 / IP54 mounted in any orientation.
11. Agency Listing: ISO 9001, cULus, and CSA C22.2 No. 24-93.
12. The manufacturer shall warrant all components for a period of 5 years from the date of production, with the first two years unconditional.

2.13 CONTROL VALVES

A. Manufacturer

1. Manufactured, brand labeled or distributed by Honeywell.

B. Control Valves: Factory fabricated of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

C. The manufacturer shall warrant all components for a period of 5 years from the date of production, with the first two years unconditional (except as noted).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that power is available to control units.

- B. Verify that piping and equipment-mounted devices are installed before proceeding with installation. Prior to starting work, carefully inspect installed work and verify that such work is complete to the point where work of this Section may properly commence.
- C. Notify the owner's representative in writing of conditions detrimental to the proper and timely completion of the work.

3.2 GENERAL WORKMANSHIP

- A. Install equipment, piping, and wiring \ raceways parallel to building lines where possible.
- B. Provide sufficient slack and flexible connections to allow for vibration.
- C. Install all equipment in readily accessible locations.
- D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
- E. All work, materials, and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as defined in section 1 of this specification.
- F. Contractor shall continually monitor the field installation for code compliance and quality of workmanship.

3.3 WIRING

- A. All wiring, conduit, accessories and wiring connections required for the installation of the Automatic Control System (Building Management System), as herein specified, shall be provided by the BAS Sub-Contractor unless specifically shown on the Electrical Drawings under Division 26 Electrical.
 - 1. All wiring shall comply with the requirements of applicable portions of Division 26 and 27, the National Electric Code, and as specified this section.
 - 2. The sizing, type and provision of cable, conduit, and raceways shall be the design responsibility of the BAS Sub-Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the BAS Sub-Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.
 - 3. Class 2 Control Wiring (24VAC or less):
 - a. Class 2 wiring may be run 'open' without conduit in concealed accessible locations (i.e. above lay-in ceiling system). Class 2 control wiring shall be run in cable tray system provided by Division 26, refer to Electrical drawings.
 - b. Class 2 wiring dropping in walls to wall-mounted control devices shall be run in 3/4 inch conduit and single-gang wall box at device location.
 - c. All 'open' control wiring shall be plenum-rated. Jacket color shall be Gray (to differentiate from other communication cables specified in Section 27 1506)
 - d. Class 2 'open' wiring not installed in cable tray or conduit shall be supported every 5' from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines.
 - e. All Class 2 wiring run exposed in spaces without ceilings (i.e. gyms, mechanical rooms, stage areas, etc.) shall be installed in conduit as specified in Division 26 sections.
 - f. All outdoor Class 2 wiring shall be run in conduit as specified in Division 26 sections.

4. Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.
5. Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.

3.4 INSTALLATION

- A. Install software in control units. Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- B. Connect and configure equipment and software to achieve sequence of operation specified.
- C. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor.
- D. Install steam and condensate instrument wells, valves, and other accessories according to Division 23 Section "Steam and Condensate Heating Piping."
- E. BAS Line Voltage Power Source
 1. 120-volt AC circuits used for the Building Management System shall be taken from panel boards and circuit breakers. Refer to the electrical drawing for locations where power is provided for control purposes. If not indicated on the electrical drawings and power is needed for control purposes the power wiring shall be run by the Contractor.
 2. Install building wire and cable according to Division 26. The Contractor shall terminate all control and \ or interlock wiring and shall maintain updated wiring diagrams with terminations identified at jobsite. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.
 3. Circuits used for the BAS shall be dedicated to the BAS and shall not be used for any other purposes.
 4. DDC terminal unit controllers may use AC power from motor power circuits.
- F. BAS Raceway:
 1. **All wiring shall be installed in conduit.** Minimum control wiring conduit size 1/2".
 2. Install conduit, boxes, and cabinets according to Division 26. All line-voltage wiring shall be UL listed and installed in approved conduit according to the NEC and Division 26 requirements.
 3. All conduits shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.
- G. Penetrations
 1. Install plenum wiring in sleeves where it passes through walls and floors. Maintain the fire rating at all penetrations.
 2. Provide fire stopping for all penetrations used by dedicated BAS conduits and raceways.
 3. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.
 4. All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.
 5. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.
- H. BAS Identification Standards

1. Node Identification. All nodes shall be identified by a permanent label fastened to the enclosure. Labels shall be suitable for the node location.
 - a. Cable types specified in Item A shall be color coded for easy identification and troubleshooting.

I. BAS Panel Installation

1. The BAS panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.
2. The BAS sub-contractor shall be responsible for coordinating panel locations with other trades and electrical and mechanical contractors.

J. Input Devices

1. All Input devices shall be installed per the manufacturer recommendation
2. Locate components of the BAS in accessible local control panels wherever possible.

K. HVAC Input Devices – General

1. All Input devices shall be installed per the manufacturer recommendation
2. Locate components of the BAS in accessible local control panels wherever possible.
3. The contractor shall install all in-line devices such.
4. Space Sensors:
 - a. Shall be mounted per ADA requirements.

L. HVAC Output Devices

1. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke

M. Electronic Signal Isolation Transducers: Whenever an analog output signal from the Building Management System is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input a signal from a remote system, provide a signal isolation transducer. Signal isolation transducer shall provide ground plane isolation between systems. Signals shall provide optical isolation between systems

3.5 CONTROL VALVE APPLICATION

- A. All control valves shall be easily accessible for servicing.
- B. All heating valves shall be spring return and shall fail open.
- C. All control valve actuators shall be 24 volt unless the application dictates another voltage. The Contractor shall provide transformers and low voltage control wiring.
- D. Provide control valve types as follows:
 1. Unit Ventilators Heating: Modulating Characterized Control Valves, pressure independent PICCV type.

2. Baseboard Heating: Modulating Characterized Control Valves, pressure independent PICCV type.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 2. Test and adjust controls and safeties.
 3. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
 4. Test each point through its full operating range to verify that safety and operating control set points are as required.
 5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 6. Test each system for compliance with sequence of operation.
 7. Test software and hardware interlocks.
- C. DDC Verification:
 1. Verify that all controllers are calibrated, commissioned, operating under all possible sequences, and properly represented on the graphic display. Verify that instruments are installed before calibration, testing, and loop or leak checks.
 2. Check instruments for proper location and accessibility.
 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
 4. Check instrument tubing for proper fittings, slope, material, and support.
 5. Check installation of air supply for each instrument.
 6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
 7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
 8. Check temperature instruments and material and length of sensing elements.
 9. Check control valves. Verify that they are in correct direction.
 10. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
 11. Check DDC system as follows:
 - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - c. Verify that spare I/O capacity has been provided.
 - d. Verify that DDC controllers are protected from power supply surges.
- D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.
- E. Confirm proper operation of all controls in the presence of the Owner or Owner's representative.

- F. Create and submit for approval, functional test forms for each piece of equipment. Approved forms to be used by controls contractor and the mechanical contractor to validate the functional operation of all HVAC equipment under DDC control. Submit signed, completed forms, to Engineer for review. Contractor to self-commission all mechanical systems.

3.7 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.
 2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
 3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
 4. Control System Inputs and Outputs:
 - a. Check analog inputs at 0, 50, and 100 percent of span.
 - b. Check analog outputs using milliamper meter at 0, 50, and 100 percent output.
 - c. Check digital inputs using jumper wire.
 - d. Check digital outputs using ohmmeter to test for contact making or breaking.
 - e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
 5. Temperature:
 - a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
 - b. Calibrate temperature switches to make or break contacts.
 6. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
 7. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
 8. Provide diagnostic and test instruments for calibration and adjustment of system.
 9. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.
- B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

3.8 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. All low voltage wiring for the ATC work shall be plenum rated and shall have purple jacket. The purple jacket is being done to easily differentiate it from other cable in the building.
- B. All line-voltage wiring shall be UL listed and installed in approved raceway according to the NEC and division 26 requirements.
- C. Install building wire and cable according to Division 26. All low-voltage wiring shall meet NEC class 2 requirements.

- D. Provide all miscellaneous devices, hardware, software, interconnections installation and programming required to ensure a complete operating system in accordance with the sequences of operation and point schedules.
- E. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.
- F. The contractor shall terminate all control and \ or interlock wiring and shall maintain updated wiring diagrams with terminations identified at jobsite. All wiring shall be identified at both ends of the terminations with service purpose and equipment tag.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 Section "Demonstration and Training."
- B. Fully commission all aspects of the Building Management System.
- C. Acceptance Check Sheet
 - 1. Prepare a check sheet that includes all points for all functions of the BAS as indicated on the point list included in this specification.
 - 2. Submit the check sheet to the Engineer for approval
 - 3. The Engineer will use the check sheet as the basis for acceptance with the BAS Sub-Contractor.

PART 4 - SEQUENCES OF OPERATION

4.1 SPECIFIC PROJECT CONTROL EQUIPMENT REQUIREMENTS

- A. Provide a freezestat for all units: A binary signal shall de-energize the supply fan, close the outside air damper, and open the heating valve when the discharge air temperature falls below 35 degrees F. This safety shall be capable of local manual reset and reset through the BAS. Upon activation an alarm shall be indicated at the BAS.
- B. Wiring requirements:
 - 1. Run control wiring in metal surface raceway only when it is not possible to conceal in the walls or ceiling space.
- C. Space temperature sensors shall be as follows:
 - 1. Locations indicated on the plan are diagrammatic. Coordinate exact mounting location in field prior to installation. Coordinate with other wall mounted equipment.
 - 2. Mount all sensors such that top of sensor assembly is 48" AFF unless other wise indicated.
 - 3. Field-coordinate locations with all cabinetry, shelving, furniture, etc. All mounted sensors shall be installed such that they conform to all ADA requirements, including, but not limited to:
 - a. Sensors located in circulation paths (i.e. corridors, halls, etc) shall be installed such that element does not encroach more than 4 inches into circulation path.
 - b. Sensors shall be installed such that there is an unobstructed forward reach. Sensor may be installed with an obstructed high forward reach when obstruction depth is less than 20 inches

AND there is a clear floor space extending beneath the element for the entire depth of the obstruction.

4. All space sensors are to be sensors with setpoint adjustment and occupied override (no display). (Wiring to all sensor only areas shall have enough wires to accommodate upgrade to the sensor with LCD screen in the future. Controller selection and spare inputs/outputs shall also be provided to accommodate local setpoint and occupied override in the future.)
- D. All system alarms shall page or e-mail or text the Facility Manager and indicate an alarm number on the Owner supplied Pager. The facility manager shall be provided with a list of alarms (by the BAS vendor) and the facility manager shall decide which high-priority alarms will be sent to an email capable mobile phone or pager.
- E. All Digital Outputs shall have HAND-OFF-AUTO (H-O-A) switches built into the DDC controller or on the panel door for Single Application and Multi-Purpose controllers. The building Operators shall be capable of overriding any Digital Output point using the H-O-A switches. The H-O-A switches shall provide feedback the DDC controller to enable control loops when in “Hand” (Manual) operation. H-O-A switches shall be provided for all used and spare points.
- F. Panels shall include a Surge Protective Device (SPD) in compliance with UL 1449 Third Edition.

4.2 GLOBAL BAS COMMANDS

- A. The following global commands and views shall be capable through the BAS. Assign these only to the highest password level.
 1. Change all heating setpoints to a common temperature.
 2. View all temperature conditions, in each space, in a section of the building.
 3. Override outside air temperature. (For use in commissioning of controls)

4.3 COMMON CONDITIONS

- A. Run Conditions: Each HVAC shall run according to a user definable, independent, time schedule.
 1. Each HVAC unit shall use an optimal start algorithm for morning start-up. This algorithm shall minimize the warm-up or cool-down period while still achieving comfort conditions by the start of scheduled occupied period. Keep the outside air dampers closed, relief dampers closed, return dampers open, energy wheels off, and exhaust fans off during the warm-up cycle prior to occupancy.
 2. Occupied Mode:
 - a. Heating Setpoint: 72°F (adj.)
 - b. The supply air fan shall energize and run continuously.
 - c. The outside air ventilation system shall energize.
 3. Unoccupied Mode:
 - a. Heating Setpoint: 60°F (adj.)
 - b. The supply air fan shall de-energize and cycle on based on need.
 - c. The outside air ventilation system shall de-energize. Keep the outside air dampers closed and return dampers open during the unocc period.

4.4 ECONOMIZER OPERATION

- A. Economizer Operation: On a call for space cooling and when the outside air enthalpy is lower than return air enthalpy the outside air shall be used for free cooling. A single outside air enthalpy sensor may be used for all spaces but each room is to have its own space enthalpy sensor. :
 - 1. Units with OA damper and relief dampers
 - a. Modulate the outside air damper open.
 - b. Modulate the return air damper closed.
 - 2. The economizer operation shall be locked out whenever:
 - a. The supply fan status is off.
 - b. Outside enthalpy is higher than return air enthalpy.
 - c. The heating valve is open.
 - d. The freeze stat is on.
- B. The economizer operation shall modulate so as to not allow the mixed air temperature to drop below 55°F (adj.)

4.5 BASEBOARD HEATER SEQUENCE OF OPERATION

- A. Enable when outside air temperature is below setpoint, 60°F (adj).
- B. On a drop in space temperature the baseboard shall energize if enabled.
- C. Provide graphic showing space temperature and valve controlled position.

4.6 UNIT VENTILATOR SEQUENCE OF OPERATION

- A. Run Conditions: The unit shall run according to a user definable, independent, time schedule.
 - 1. The unit shall use an optimal start algorithm for morning start-up. This algorithm shall minimize the warm-up or cool-down period while still achieving comfort conditions by the start of scheduled occupied period. Keep the outside air damper closed and exhaust fans off during the warm-up cycle prior to occupancy.
 - 2. Occupied Mode:
 - a. Cooling Setpoint: 76°F (adj.)
 - b. Heating Setpoint: 72°F (adj.)
 - c. Humidity Setpoint: 60% rh (adj.)
 - d. For unit ventilators the supply fan shall start in high speed for approximately five minutes, then operate at selected speed while in the occupied mode. The supply air fan shall run continuously.
 - e. The outside air damper shall open to the minimum position and the return damper shall partially close.
 - f. The designated minimum ventilation exhaust fan shall energize.
 - g. The relief dampers shall remain closed except for economizer mode.
 - 3. Unoccupied Mode:

- a. Cooling Setpoint: 85°F (adj.)
 - b. Heating Setpoint: 60°F (adj.)
 - c. Humidity Setpoint: 60% rh (adj.)
 - d. The fan shall cycle on a call for conditioning and the outside air damper shall be in the closed position and the return air damper in the full open position.
 - e. The designated minimum ventilation exhaust fan shall de-energize.
 - f. The relief dampers shall remain closed except for economizer mode.
- B. Cooling: The controller shall measure the space temperature and modulate the chilled water valve open to maintain cooling setpoint. The fan shall initially run at low speed. If space setpoint cannot be obtained when the valve is in the full open position the fan speed shall be increased. The cooling coil valve shall be enabled whenever:
1. Outside air temperature is greater than 60°F (adj.).
 2. The space temperature is above cooling setpoint.
 3. The humidity level is above setpoint.
- C. Economizer Operation: For all unit ventilators use a global outside air sensor determine if outside air can be used for cooling. Measure outside air temperature and humidity. If outside air can be used for cooling the outside air damper at each UV shall modulate open and the return damper close. Once the OA damper is open beyond the minimum ventilation position the relief dampers shall open. If open and cooling setpoint can still not be maintained the chilled water valve shall then modulate open. When in the economizer mode and in occupied mode the minimum ventilation exhaust fan shall continue to run.
- D. Heating: On a drop in room temperature the hot water coil valve shall modulate open. The fan shall initially run at low speed. If space setpoint cannot be obtained when the valve is in the full open position the fan speed shall be increased. On a rise in space temperature the reverse shall occur. The heating shall be enabled whenever:
1. Outside air temperature is less than 65°F (adj.).
 2. The space temperature is below heating setpoint.
 3. The humidity level is above setpoint.
- E. Dehumidification Mode: Monitor space humidity level with wall mounted sensor. When a high level is reached an alarm shall activate. The operator shall then initial dehumidification mode through the BAS. Include a graphic switch that is off-on timer. When positioned to “on” the dehumidification mode shall run for 24 hours. In this mode, when humidity is above setpoint, the UV shall open the chilled water valve fully and modulate the heating valve to maintain space temperature. The boiler and pumps shall be operational regardless of outside air temperature.
- F. User Overrides: The following shall be capable of automatic, manual off, or manual on control through the BAS. The override control shall remain effective until reset by the user through the BAS.
1. Supply Fan
 2. Cooling valve
 3. Heating valve
 4. Outside, return, relief air dampers.
 5. Exhaust Fan
- G. Safeties and Alarms: An alarm condition shall be generated at the BAS upon:
1. Control Board loss of communication
 2. High Space Temperature, 5°F (adj.) above setpoint.
 3. Low Space Temperature, 5°F (adj.) below setpoint.

4. High Space Humidity, 10% rh (adj.) above setpoint.
5. Low Mixed Air Temperature, below 45°F (adj.)
6. Low Discharge Air Temperature, below 50°F (adj.)
7. Fan Failure: Commanded on, but status is off or commanded off and status is on.
8. Low limit (freezestat)

H. Filter Status:

1. A maintenance timer shall be incorporated into the sequence to signal a filter change after a configurable number of fan run hours. Provide this feature for all units.

I. System Graphic: Provide a dynamic computerized graphical representation of the unit and components. The user shall be capable of viewing and adjusting setpoints and operational conditions of the following:

SEQ-5 POINTS	Graphic	Hardw. Input	Hardw. Output	Override capability	Alarm	NOTES
Space temperature and setpoint adjustment for heating and cooling modes	x	AI	AO		x	
Supply fan speed control	x		BI		x	
Supply fan status		AI				CSS for status
Dehumidification Operation	x					Refer to separate control sequence
Deadband: There shall be a 4°F (adj.) deadband between energizing the heating and cooling valves	x				x	
Discharge air temperature	x	AI			x	
Mixed air temperature	x	AI				Low limit alarm
Economizer Operation Status	x				x	
Cooling valve	x		AO			Controlled position
Heating valve	x		AO			Controlled position
Return/Outside air damper	x		AO			Controlled position
Schedule for occ/unocc	x					
Relief air damper	x		AO			Controlled position
Min Ventilation exhaust fan	x		BO			
Min Ventilation EF Status	x	BI				CSS for status

END OF SECTION 230900

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
 - 1. Hot-water heating piping.
 - 2. Chilled water piping
 - 3. Condensate-drain piping.
- B. Related Sections include the following:
 - 1. Division 23 Section “Basic Piping Material and Methods”.
 - 2. Division 23 Section “Basic Mechanical Materials and Methods” for general piping materials and installation requirements.
 - 3. Division 23 Section “Hangers and Supports” for pipe supports, product descriptions and installation requirements.

1.3 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 - 2. Hydronic specialties.
- B. Welding certificates.
- C. Qualification Data: For Installer.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
- B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. All grooved couplings, and fittings, valves and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
 1. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.
- D. International Mechanical Code.

1.5 COORDINATION

- A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, plumbing piping, HVAC equipment, fire-suppression system components, and partition assemblies.
- B. Coordinate pipe sleeve installations for foundation wall penetrations.
- C. Coordinate pipe fitting pressure classes with products specified in related Sections.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Pressure-Reducing Valves:
 - a. Amtrol, Inc.
 - b. Conbraco Industries, Inc.
 - c. ITT Bell & Gossett; ITT Fluid Technology Corp.
 - d. Watts Industries, Inc.; Watts Regulators.
 - e. Or approved equal
 2. Expansion Tanks:
 - a. Amtrol, Inc.
 - b. ITT Bell & Gossett; ITT Fluid Technology Corp.
 - c. Taco, Inc.
 - d. Or approved equal
 3. Air Separators and Air Purgers:

- a. Amtrol, Inc.
 - b. ITT Bell & Gossett; ITT Fluid Technology Corp.
 - c. Taco, Inc.
 - d. Or approved equal
4. Copper Press Fittings:
- a. Viega, 17545 Daleview Dr., Lakewood, OH 44107, 877.620.0016, www.viega-na.com
 - b. Nibco Inc., 1516 Middlebury St. Elkhart, IN 46516, 1-800-234-0227, www.nibco.com
 - c. Elkhart Products Corporation, 1255 Oak Street, Elkhart IN 46514, 1-800-284-4851, www.elkhartproducts.com
 - d. Or approved equal

The Nibco system requires its own special tool. The Elkhart Xpress and Viega Pro-Press use the same Rigid tool.

2.2 PIPING MATERIALS

MATL TYPE	PIPE SIZE	PIPE TYPE	PIPE SPEC	FITTING TYPE	FITTING SPECIFICATIONS
1	2" & Smaller	Sch. 40 Black Steel, Screwed End	ASTM A53 / A53m	Class 150 Black Malleable Iron, Screwed	ASME B16.3
2	All Sizes	Type 'L' Hard-Drawn Copper	ASTM B88	Wrought or cast Solder Joint Grooved	ANSI B16.22 ANSI B16.18

2.3 FITTINGS

- A. Press Fittings: Copper press fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.22. O-rings for copper press fittings shall be EPDM.
- B. Cast-Iron Threaded Fittings: ANSI B16.4, Class 125, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.
- C. Malleable-Iron Threaded Fittings: ANSI B16.3, Class 150, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.
- D. Steel Fittings: ASTM A 234, seamless or welded, for welded joints.
- E. Wrought-Copper Fittings: ANSI B16.22, streamlined pattern.
- F. Cast-Iron Threaded Flanges: ANSI B16.1, Class 125; raised ground face, bolt holes spot faced.

- G. Cast Bronze Flanges: ANSI B16.24, Class 150; raised ground face, bolt holes spot faced.
- H. Steel Flanges and Flanged Fittings: ANSI B16.5, including bolts, nuts, and gaskets.
- I. Unions: ASME B16.39 malleable-iron, Class 150, hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends. Threads shall conform to ANSI B1.20.1.
- J. Dielectric Unions or Waterway Fittings: Threaded, grooved, or soldered end connections for the pipe materials in which installed; constructed to isolate dissimilar metals, prevent galvanic action, and prevent corrosion. Basis of Design: Victaulic Style 47 and 647.
- K. Flexible Connectors: Stainless steel bellows with woven flexible bronze wire reinforcing protective jacket; minimum 150 psig working pressure, maximum 250 degree F operating temperature. Connectors shall have flanged or threaded end connections to match equipment connected; and shall be capable of 3/4 inch misalignment.
 - 1. Four Victaulic flexible couplings may be used in lieu of flexible connectors for vibration attenuation. The couplings shall be placed in close proximity to the source of the vibration.

2.4 JOINING MATERIALS

- A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- 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.
- C. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel
 - 1. WARNING: Some filler metals contain compounds, which produce highly toxic fumes when heated. Avoid breathing fumes. Provide adequate ventilation.
- D. Gasket Material: thickness, material, and type suitable for fluid to be handled, and design temperatures and pressures.

2.5 VALVES

- A. Balancing, check, ball, and butterfly valves are specified in Division 15 Section "Valves".
- B. Refer to Part 3 "Valve Applications" Article for applications of each valve.

2.6 HYDRONIC SPECIALTIES

- A. Manual Air Vent: Bronze body and nonferrous internal parts; 125-psig working pressure; 240 deg F operating temperature; manually operated with screwdriver or thumbscrew; with NPS 1/8 discharge connection and NPS 1/2 inlet connection.
- B. Automatic Air Vent: Designed to vent automatically with float principle; bronze or cast-iron body and nonferrous internal parts; 150-psig working pressure; 240 deg F operating temperature; with NPS 3/4 discharge connection and NPS 3/4 inlet connection

- C. Y-Pattern Strainers: 300-psig working pressure; ductile-iron body (ASTM A 536, Grade 65-45-12) with grooved ends or cast-iron body (ASTM A 126, Class B), flanged ends for NPS 2-1/2 and larger, threaded connections for NPS 2 and smaller, bolted cover, perforated stainless-steel basket, and bottom drain connection.
- D. Flexible Connectors: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig minimum working pressure and 250 deg F maximum operating temperature. Connectors shall have flanged- or threaded-end connections to match equipment connected and shall be capable of 3/4-inch misalignment.

2.7 HYDRONIC SPECIALTIES

- A. Manual Air Vent: Bronze body and nonferrous internal parts; 125-psig working pressure; 240 deg F operating temperature; manually operated with screwdriver or thumbscrew; with NPS 1/8 discharge connection and NPS 1/2 inlet connection.
 - 1. Acceptable Product: www.taco-hvac.com Taco Inc. “Taco 417 Vent”EXECUTION

3.1 PIPING APPLICATIONS

<u>SERVICE</u>	<u>PIPE MATERIAL TYPE</u>
Hot & Chilled Water	1 & 2
Condensate Drains	2

- A. Press Fittings may be used for copper heating applications provided approved o-rings are used. Copper press fittings shall be made in accordance with the manufacturer’s installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer.

3.2 VALVE APPLICATIONS

- A. General-Duty Valve Applications: Unless otherwise indicated, use the following valve types:
 - 1. Shutoff Duty: Ball, OS&Y, and butterfly valves.
 - 2. Balancing: Balancing Valves, (Refer to 230523)
- B. Install shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.
- C. Install calibrated balancing valves in the return water line of each heating or cooling element and elsewhere as required to facilitate system balancing. Coordinate with the Testing and Balancing Technician.

3.3 PIPING INSTALLATIONS

- A. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for basic piping installation requirements..
- B. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Locations and arrangements of piping take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.
- C. Use fittings for all changes in direction and all branch connections. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1" clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal. Install drains at all low points in mains, risers, and branch lines consisting of a tee fitting, 3/4" ball valve, and short 3/4" threaded nipple and cap.
- D. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6 inch shall be steel; pipe sleeves six inches and larger shall be sheet metal.
- E. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, and floors, maintain the fire rated integrity. Seal penetrations to maintain assembly UL rating.
- F. Install dielectric nipples or unions to join dissimilar metals.
- G. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- H. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- I. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- J. Unless otherwise indicated, install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the bottom of the main pipe. For up-feed risers, install the takeoff coming out the top of the main pipe.
- K. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
- L. Anchor piping for proper direction of expansion and contraction.

3.4 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment". Comply with requirements below for maximum spacing of supports.
- B. Install the following pipe attachments:
 - 1. Adjustable galvanized steel clevis hangers for individual horizontal piping less than 20 feet long.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

- | | | | |
|----|-----------|---------------------|----------------------------|
| 1. | NPS 3/4 | Maximum Span: 7 ft | Minimum rod size: 1/4 inch |
| 2. | NPS 1 | Maximum Span: 7 ft | Minimum rod size: 1/4 inch |
| 3. | NPS 1-1/2 | Maximum Span: 9 ft | Minimum rod size: 3/8 inch |
| 4. | NPS 2 | Maximum Span: 10 ft | Minimum rod size: 3/8 inch |
| 5. | NPS 2-1/2 | Maximum Span: 11 ft | Minimum rod size: 3/8 inch |
| 6. | NPS 3 | Maximum Span: 12 ft | Minimum rod size: 3/8 inch |

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

- | | | | |
|----|-----------|--------------------|----------------------------|
| 1. | NPS 3/4 | Maximum Span: 5 ft | Minimum rod size: 1/4 inch |
| 2. | NPS 1 | Maximum Span: 6 ft | Minimum rod size: 1/4 inch |
| 3. | NPS 1-1/2 | Maximum Span: 8 ft | Minimum rod size: 3/8 inch |
| 4. | NPS 2 | Maximum Span: 8 ft | Minimum rod size: 3/8 inch |

3.5 PIPE JOINT CONSTRUCTION

A. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for joint construction requirements for soldered and brazed joints in copper tubing; threaded, welded, and flanged joints in steel piping.

3.6 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents in mechanical equipment rooms only at high points of system piping, at heat-transfer coils, and elsewhere as required for system air venting. Extend drain to floor drain.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Size for supply and return piping connections shall be same as for equipment connections

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If multiple, parallel control valves are installed, only one bypass is required.

D. Install ports for pressure and temperature gages at coil inlet connections.

3.8 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
1. Leave joints, including welds, un-insulated and exposed for examination during test.
 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 3. Flush system with clean water. Clean strainers
 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 2. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of test liquid.
 3. Check expansion tanks to determine that they are not air bound and that system is full of water.
 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping".
 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components and repeat hydrostatic test until there are no leaks.
 6. Prepare written report of testing.

3.9 ADJUSTING

- A. Mark calibrated nameplates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.
- B. Perform these adjustments before operating the system:
1. Open valves to fully open position. Close coil bypass valves.
 2. Set automatic fill valves for required system pressure.
 3. Check air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 4. Set temperature controls so all coils are calling for full flow.

3.10 CLEANING

- A. Flush hydronic piping systems with clean water. Remove and clean or replace strainer screens. After cleaning and flushing hydronic piping systems, but before balancing, remove disposable fine-mesh strainers in pump suction diffusers.

END OF SECTION 232113

SECTION 233113 – METAL AND NONMETAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.
6. Flexible Class I Air Ductwork.

- B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible duct connections.
3. Division 23 Section "HVAC Insulation" for fire-rated insulation systems.

1.3 DEFINITIONS

- A. Thermal Conductivity and Apparent Thermal Conductivity (k-value): As defined in ASTM C 168. In this section, these values are the result of the formula $[(\text{Btu}) \times (\text{in/hr}) \times (\text{sq. ft.}) \times (\text{deg F})]$ or $[(\text{W/m}) \times (\text{K})]$ at the temperature differences specified. Values expressed as Btu or W.

1. Example: Apparent Thermal Conductivity (k-value): 0.26 or 0.037.

1.4 SYSTEM DESCRIPTION

- A. Duct system design, as indicated, has been used to select and size air-moving and distribution equipment and other components of air systems. Changes to layout or configuration of duct system must be specifically approved in writing by Engineer. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.5 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"

1.6 SUBMITTALS

- A. Product Data: For each type of the following products:
1. Liners and adhesives.
 2. Sealants and gaskets.
- B. Shop Drawings from duct fabrication shop, drawn to a scale not smaller than 1/4" equals 1 foot, on drawing sheets same size as the Contract Drawings, detailing:
1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 2. Factory- and shop-fabricated ducts and fittings.
 3. Indication of ductwork construction materials.
 4. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
 5. Elevation of top of ducts.
 6. Dimensions of main duct runs from building grid lines.
 7. Fittings.
 8. Reinforcement and spacing.
 9. Seam and joint construction.
 10. Penetrations through fire-rated and other partitions.
 11. Equipment installation based on equipment being used on Project.
 12. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
 13. Hangers and supports, including methods for duct and building attachment, and vibration isolation.
 14. Coordination with building structure and space available based on actual steel shop drawings.
- C. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 2. Suspended ceiling components.
 3. Structural members to which duct will be attached.
 4. Size and location of initial access modules for acoustical tile.
 5. Penetrations of smoke barriers and fire-rated construction.
 6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
- D. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.

1.7 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems," unless otherwise indicated.
- B. Comply with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems," unless otherwise indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sealant and firestopping materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials. Store and handle sealant and firestopping materials according to manufacturer's written recommendations.
- B. Deliver and store all ductwork so it remains dry and free of any dirt or dust.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- C. Exposed round ducts shall have Longitudinal Seam positioned on the top.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 DUCT LINER

- A. Flexible Elastomeric (Non-Fibrous) Duct Liner:
 - 1. General Properties:
 - a. Operating Temperature (max) – ASTM C 411: 180°F.
 - b. Air Velocity (max) – ASTM C 1071: 10,000 ft/min.
 - c. Mold Resistance – UL 181: Meets Requirements.
 - d. Fungi Resistance – ASTM G 21: Meets Requirements.
 - e. Bacteria Resistance – ASTM G 22: Meets Requirements.
 - f. Maximum Flame Spread Index - UL 723, NRTL Certified: 25.
 - g. Maximum Smoke Developed Index - UL 723, NRTL Certified: 50.
 - h. UL Listed.
 - i. Microban® Antimicrobial protection.
 - j. Comply with NAIMA AH124, "Fibrous Glass Duct Liner Installation Standard."

Sound Absorption Coefficients: Thickness	Sound Absorption Coefficient at Frequency (Cycles per Second)						
	125	250	500	1000	2000	4000	NRC
1 Inch	0.08	0.22	1.03	0.37	0.68	0.50	0.60

2. Manufacturers: Subject to compliance with requirements, provide products by the following or an approved equal indicating compliance with the above mentioned properties and the published sound absorption coefficients for the Acceptable Product, listed below:
 - a. Armacell LLC.
3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
 - a. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
4. Acceptable Product: Armacell, Model 'AP Coilflex™ Conformable Duct Liner'.

2.5 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
 1. Application Method: Brush on.
 2. Solids Content: Minimum 65 percent.
 3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. VOC: Maximum 75 g/L (less water).
 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 8. Service: Indoor or outdoor.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- C. Flanged Joint Sealant: Comply with ASTM C 920.
 1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.
- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.6 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- G. Trapeze and Riser Supports
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

2.7 FLEXIBLE CLASS I AIR DUCT

- A. Ductwork systems shall be UL-181 approved for Class I air ducts. Ductwork systems shall meet the requirements of NFPA 90A and 90B and UMC 6-1. This is pre-insulated, round air duct with a reinforced grey polyester outside jacket enclosing fiberglass insulation wrapped around continuous inner air barrier film reinforced with an encapsulated steel wire helix. Installation shall be in accordance with manufacturer's recommendations including hangers and spacing. Maximum allowable length of flexible air duct shall be 6'-0". Install only where indicated on drawings.
 - 1. Insulation Thickness: Insulation thickness and resulting insulation R-Value shall meet all requirements stipulated within Section 230700.
 - 2. Acceptable Products:
 - a. JP Lamborn Co, Model RPR-25R6 (R-6 Insulation Value).
 - b. JP Lamborn Co, Model RPR-25R8 (R-8 Insulation Value).
 - c. Or equal

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness and connective flanging.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Install ductwork so as not to encroach on required clearances above or around electrical panels.
- K. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- L. Where ducts pass through fire-rated interior partitions seal the penetrations with UL rated method.
- M. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 DUCT SEALING

- A. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 2. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
 - 3. Conditioned Space, Exhaust Ducts: Seal Class B.
 - 4. Conditioned Space, Return-Air Ducts: Seal Class C.

3.3 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: structural-steel fasteners appropriate for construction materials to which hangers are being attached.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.4 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with 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.

3.5 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

3.7 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated.
- B. Minimum duct seal level requirements
 - 1. Unless otherwise indicated, construct ducts to the followings static-pressure classifications:
 - a. Supply Ducts: 2-inch wg.
 - b. Return Ducts: 2 inch wg, negative pressure
 - c. Exhaust Ducts: 2-inch wg, negative pressure
- C. Internal Duct Liner:
 - 1. Where indicated on the plans use soft elastomeric foam liner, 1 inch thick.
- D. Elbow Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 - 2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."

- a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Radius-to Diameter Ratio: 1.5.
- b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
- c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

E. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
 - 1) Acceptable Product: Acme Model No. 176.
2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.

3.8 APPLICATION OF LINER IN RECTANGULAR DUCTS

- A. Install internal liner on ducts as indicated on the drawings.
- B. Duct sizes indicated on the drawings are net free area. Increase duct sizes indicated on the drawings to allow for the internal liner.
- C. Adhere a single layer of indicated thickness of duct liner with 90 percent coverage of adhesive at liner contact surface area. Multiple layers of insulation to achieve indicated thickness are prohibited.
- D. Apply adhesive to liner facing in direction of airflow not receiving metal nosing.
- E. Butt transverse joints without gaps and coat joint with adhesive.
- F. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
- G. Do not apply liners in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.
- H. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely around perimeter; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
- I. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profile or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 1. Fan discharge.
 2. Intervals of lined duct preceding unlined duct.

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- J. Terminate liner with duct buildouts installed in ducts to attach dampers, turning vane assemblies, and other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct wall with bolts, screws, rivets, or welds. Terminate liner at fire dampers at connection to fire-damper sleeve.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Manual volume dampers.
 - 2. Control dampers.
 - 3. Flange connectors.
 - 4. Duct-mounted access doors and panels.
 - 5. Flexible connectors.
 - 6. Turning vanes.
 - 7. Duct accessory hardware.
- B. Related Sections:
 - 1. Division 23 Section "Ductwork".
 - 2. Division 23 Section "HVAC Insulation"

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Manual-volume dampers.
 - 2. Control dampers, including leakage rate data in (cfm/ft² @ in. wg).
 - 3. Access Doors.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings and manual- and control-volume damper installations
 - b. Wiring Diagrams: For power, signal, and control wiring.
- C. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 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: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
- D. 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

2.2 MANUAL VOLUME DAMPERS – STEEL:

- A. General: 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 Classifications 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: Single blade or multiple, opposed-blade design unless otherwise indicated on drawings, standard leakage rating, with linkage outside air stream, and suitable for horizontal or vertical applications.
 - 1. Steel Frames: Hat-shaped, galvanized, sheet steel channels, minimum of 20 gauge thick, with mitered and welded corners; frames with flanges for attaching to walls; and flangeless frames for installing in ducts.
 - 2. Roll-Formed Steel Blades: 0.064-inch thick, galvanized, sheet steel.
 - 3. Blade Axles: Galvanized steel.
 - 4. Tie Bars and Brackets: Galvanized steel.
 - 5. Provide with standoff bracket on ducts that are insulated.
- C. Acceptable Volume Damper: www.greenheck.com Greenheck Fan Corporation Model MBD-15 rectangular or MBDR-50 round. Or equivalent by Ruskin or Nailer, Or approved equal

2.3 LOW LEAK CONTROL DAMPERS - STEEL

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Greenheck Fan Corporation.
 2. McGill AirFlow LLC.
 3. METALAIRE, Inc.
 4. Nailor Industries Inc.
 5. Ruskin Company.
 6. Vent Products Company, Inc.
 7. Young Regulator Company.
 8. Or approved equal
- B. Damper actuators are specified in section 230900 – “Automatic Control Systems”.
- C. Low-leakage rating, with linkage outside air stream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
1. Minimum leakage rating: 4 cfm/ft² @ 1 in. wg.
- D. Frames:
1. Hat shaped.
 2. Galvanized steel channels, 0.064 inch thick.
 3. Mitered and welded corners.
- E. Blades:
1. Blades shall be double-skin, airfoil type.
 2. Multiple blades with maximum blade width of 8 inches.
 3. Opposed blade design.
 4. Galvanized Steel.
 5. 0.064 inch thick.
 6. Blade Edging: EPDM rubber blade seals.
- F. Blade Axles: 1/2-inch diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
1. Operating Temperature Range: From minus 40 to plus 200 deg F.
- G. Bearings:
1. Dampers in ducts with pressure classes of 3-inch w/g or less shall have axles, full length of damper blades and bearings at both ends of operating shaft.
 2. Thrust bearings at each end of every blade.
- H. Acceptable Low Leak Control damper: www.greenheck.com; Greenheck Fan Corporation Model No. VCD-33.

2.4 FLANGE CONNECTORS

- 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. Ductmate Industries, Inc.
 2. Nexus PDQ; Division of Shilco Holdings Inc.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
 4. Or approved equal
- B. Description: Roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Provide material compatible with duct materials.
- D. Gauge and Shape: Match connecting ductwork.

2.5 DUCT-MOUNTED ACCESS DOORS

- 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 Warming and Ventilating; a division of Mestek, Inc.
 2. Acudor Products, Inc.
 3. Ductmate Industries, Inc.
 4. Greenheck Fan Corporation.
 5. McGill AirFlow LLC.
 6. Nailor Industries Inc.
 7. Pottorff; a division of PCI Industries, Inc.
 8. Or approved equal
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 inches: Three hinges and two compression latches with outside and inside handles.
 - d. Access Doors Larger than 24 by 48 inches: Four hinges and two compression latches with outside and inside handles.
 4. Acceptable Duct-Mounted Access Door: www.acudor.com: Acudor Model No. HD-5070

2.6 FLEXIBLE DUCTS

- 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. Flexmaster U.S.A., Inc.
 2. McGill AirFlow LLC.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
 4. Or approved equal
- B. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
1. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
 2. Maximum Air Velocity: 4000 fpm.
 3. Temperature Range: Minus 20 to plus 175 deg F.
 4. Insulation R-Value: Comply with ASHRAE/IESNA 90.1-2004.
 5. Acceptable Product: www.flexmasterusa.com: Flexmaster USA Product No. Type 5B Flex Duct.
- C. Flexible Duct Connectors:
1. Clamps: Nylon strap in sizes 3 through 18 inches to suit duct size.

2.7 TURNING VANES

- A. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vaness and Vane Runners," and 2-4, "Vane Support in Elbows."
- B. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.8 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel
- C. Low leak dampers shall be used when separating conditioned air and outside ambient air and as follows:

1. Provide low leak dampers in the duct or fan throat for all exhaust fans.
 - D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Dampers are to be installed at a minimum of two duct diameters from fitting. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 1. Install steel volume dampers in steel ducts.
 - E. Set dampers to fully open position before testing, adjusting, and balancing.
 - F. Install test holes at fan inlets and outlets and elsewhere as indicated.
 - G. Install turning vanes so that the leading and trailing edges are in the direction of the desired airflow direction.
 - H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 1. On both sides of new and existing duct coils.
 2. Control devices requiring inspection.
 - I. Install access doors with swing against duct static pressure.
 - J. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
 - K. Connect flexible ducts to metal ducts with draw bands.
 - L. Install duct test holes where required for testing and balancing purposes.
- 3.2 FIELD QUALITY CONTROL
- A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 3. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300

SECTION 260010 - GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to the sections of Division 26, 27 and 28.

1.2 SUMMARY

- A. This Section includes general administrative and procedural requirements for Electrical, Communications, and Safety/Security system installations. It is intended to supplement Division 1 sections. Any conflicts shall be brought to the attention of the Architect/Engineer for clarification.

1.3 DRAWINGS

- A. The Electrical work is generally indicated on the Electrical Drawings, but additional related information and details may appear on other project drawings, and these shall become a part of the Electrical Contract. All project drawings are intended to be complimentary.
 - 1. Refer to the Architectural drawings, when applicable, for information such as locations of fire rated assemblies, ceiling types and heights, etc.
 - 2. The Architectural Drawings and details shall govern the location and arrangement of equipment, mounting heights, and similar conditions within finished spaces.
 - 3. Notify the Architect/Engineer of any discrepancies between any of the drawings and/or the specifications.
- B. The Drawings are diagrammatic in nature and indicate the general configuration of the work. All work that will be required for the actual installation is not necessarily indicated due to the scale of the drawings. Coordinate the actual installation of all work with all other building system components and other Contractors, and provide all necessary coordination, offsets, accessories, materials, etc. as part of the work.

1.4 PERMITS, FEES AND CODES

- A. Perform all work in compliance with the codes, laws, ordinances, rules or regulations of federal, state, or local Authorities Having Jurisdiction over the premises. All such codes, laws, ordinances, rules and regulations are hereby incorporated and made a part of these specifications.
- B. Work shall be done in accordance with, but not limited to, the applicable sections of the latest edition and supplement to the following Codes and Standards:
 - 1. ANSI American National Standard Institute
 - 2. ASTM American Society for Testing and Materials
 - 3. IBC International Building Code
 - 4. IMC International Mechanical Code
 - 5. IEEE International energy Conservation Code

6. IEEE Institute of Electrical and Electronics Engineers
7. NEMA National Electrical Manufacturers Association
8. NFPA National Fire Protection Association
9. NEC National Electric Code
10. UL Underwriters Laboratories, Inc.
11. All relevant sub-codes adopted by the local AHJ.

- C. The drawings and specifications are not intended to conflict with the above documents. Request clarifications from the Architect/Engineer regarding discrepancies between relevant codes and the drawings and specifications prior to bidding. Submission of a bid shall indicate that bidder is familiar with the applicable code requirements and has included such work in the bid.

1.5 MATERIALS AND EQUIPMENT

- A. All materials and equipment shall be new, and shall conform to the grade, quality and standards specified. Where required by applicable bidding requirements and Division 1 sections, materials and equipment shall meet applicable USA steel certifications and/or shall be manufactured in the USA. Equipment shall be installed in strict accordance with manufacturer's instructions for type and capacity of equipment used. Manufacturer's instructions shall be considered part of the specifications. Type, capacity and application of equipment shall be suitable and shall operate satisfactorily for the purpose intended.
- B. Equipment used as the basis-of-design as indicated on the Drawings defines the general space requirements, weights and related services (connections), etc. Provide equipment of similar size, requirements and clearances which shall not necessitate revisions to the building construction or other trades. If revisions are required due to substitution the Contractor shall pay all costs for any required revisions. No revisions shall be made without Architect/Engineer's written approval.

1.6 CUTTING AND PATCHING

- A. All Cutting and Patching shall be completed in accordance with Division 1, Cutting and Patching section.
- B. General: All cutting and patching shall be done by mechanics experienced in their respective lines of work.
1. All cutting shall minimize damage to adjacent surfaces. If damage occurs the Contractor shall replace or repair the damaged materials with new materials in a manner approved by the Architect/Engineer.
 2. When necessary to cut and remove portions of any walls, floors, ceilings, roof or sitework to perform the work, Contractor shall perform cutting and fitting, remove all excess material, and patch or replace all damaged construction in a manner approved by the Architect/Engineer.
 3. No cutting shall be done which may affect the building structurally or architecturally. Any damage incidental to cutting or other causes in the performance of this Contract shall be made good by replacement or repairs. Cutting shall be done only with the prior approval of the Architect
 4. Patch all openings left in existing finished walls, floors and ceilings when obsolete materials are removed. Match adjacent construction and finishes.
- C. Patch and/or seal all openings or penetrations made in fire rated floors, ceilings or partitions after work has been installed. The material used for sealing the openings shall have a fire rating equal to or greater than the rating of the floor, ceiling or partition material. All fire sealant material shall be U.L. classified and approved by the Architect/Engineer.

1.7 TESTS AND CERTIFICATIONS

- A. The following requirements are supplementary to test requirements specified in individual equipment or systems Sections.
1. Written notice of test date shall be given to Architect/Engineer and other parties at least 72 hours prior to tests.
 2. Concealed work shall remain uncovered until required tests have been completed
 3. Conduct preliminary test of equipment as soon as conditions permit. Make changes, adjustments, or replacements based on test results prior to final acceptance tests.
 4. Conduct performance and operating tests for each system or equipment in presence of the Architect/Engineer. Coordinate testing with the manufacturer's representative and/or AHJ when required.
 5. Furnish labor, material, and instruments and include all other costs in connection with tests.
 6. Obtain certificates of approval and/or acceptance in compliance with regulations of AHJ. Work shall not be complete until such certificates have been delivered to the Architect/Engineer and Owner.
- B. Contractor shall certify after testing that all systems and equipment operate safely, efficiently, and in accordance with manufacturer's instructions and the intent of the drawings and specifications.

1.8 SUBSTITUTIONS

- A. Various products are used as the Basis-of-Design for systems and equipment and are specified by a manufacturer's name and model number. Unless otherwise indicated, other manufacturer's products may be submitted for consideration as a substitution in accordance with the requirements set forth in Instructions to Bidders and/or Division 1 sections, and as follows.
1. The Architect/Engineer shall be the sole judge as to the acceptance of a product that is submitted for acceptance as a substitution
 2. The proposed substitute shall include all labor and materials required to install and operate the equipment in accordance with the original design concept, including the cost of any changes to work under this section, or other sections or Contracts, such as; access openings, equipment pads, supports, pipe or duct connections, motors, controls, electrical and control wiring.
 3. Contractor shall verify that substitute equipment will fit into the designated spaces, verify that dimensions provide adequate space for the equipment and allow clearances for connections and servicing, and verify acceptance of any additional costs from other Contractors resulting from the substitute product, prior to submission to the Architect/Engineer for acceptance.

1.9 SUBMITTALS AND SHOP DRAWINGS

- A. General: Follow the procedures specified in Division 1 "Submittals".
- B. After acceptance of the Submittal Schedule, submit Shop Drawings and Submittals and obtain acceptance of the Architect/Engineer before any equipment is ordered or work is accomplished. Verify the required number of copies of each submittal to be submitted.
1. Submittals shall be in the form of clearly legible manufacturers printed catalogs, CAD-generated drawings, pamphlets, technical data, test information, and installation instructions. Clearly indicate the location, service and function of each particular item. Identification shall be made in ink with specific model numbers highlighted and accessories highlighted.

2. Submittals shall be completely referenced and identified. Descriptive information and data shall be complete. Submittals which only show partial or general information will not be acceptable and will be returned.
 3. Contractor shall inform the Engineer, in writing, of any deviations in the shop drawings and submittals where the submitted item deviates from the Contract Documents. This written advisory shall accompany the initial submittal and shall state the reasons for the deviations.
- C. Contractor shall be responsible for dimensions that are to be confirmed at the job site, for coordination in the ordering and assembly of systems and equipment, for information that pertains solely to fabrication processes or to techniques of construction, and for coordination of the work of all trades.
- D. The following specific items and information shall be included in all Shop Drawings and Submittals:
1. Capacity and performance data as shown on the Equipment Schedules or as specified.
 2. Complete descriptive data on the systems, equipment and specialties which are specified, scheduled, or shown, so that compliance with the Contract Documents can be determined.
 3. Electrical wiring diagrams (power and control) for electric motor driven equipment.

1.10 COORDINATION AND COORDINATION DRAWINGS

- A. General: Follow the procedures specified in Division 1 “Coordination Drawings”.
- B. Contractor and sub-contractors shall coordinate the installation of all equipment and material.
- C. Layout of building systems, equipment, fixtures, piping, ductwork, conduit, specialty items, and accessories indicated on the Contract Drawings is diagrammatic. Variations in alignment, elevation, and detail will be required to avoid interference and satisfy architectural and structural limitations. All such variations are not necessarily indicated.
- D. Coordination drawings shall be prepared, reviewed and coordinated in advance of any work being performed in any area.
1. Prepare plans, sections and elevations to indicate the proposed locations of fixtures, piping, ductwork, conduit, equipment, and materials. Include the following:
 - a. Clearances for installing and maintaining insulation.
 - b. Clearances for servicing and maintaining equipment, including access door openings and component removal
 - c. Equipment connections, mounting and support details.
 - d. Fire-rated wall and floor penetrations.
- E. Prepare overall coordinated reflected ceiling plans which shall include, but not be limited to, air outlets and inlets, light fixtures, communication systems components, sprinklers, access doors, and other ceiling-mounted equipment or items.
1. All Contractors shall carefully check all the drawings and coordinate their work with the general Contractor and all trades to provide a symmetrical and coordinated ceiling. Ceiling T-bars, lights, diffusers, and other equipment shall all be symmetrically installed with provisions made for integrating the T-bars and mechanical or electrical equipment. Failure to coordinate the work will result in relocation of ceiling components as directed by the Architect/Engineer at the Contractor's expense.

1.11 TRAINING AND INSTRUCTIONS

- A. General: Follow the procedures specified in Division 1 "Demonstration and Training".

1.12 ELECTRICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of systems, materials, and equipment. Comply with the following requirements:
1. Coordinate systems, equipment, and materials installation with other building components.
 2. Verify all dimensions by field measurements.
 3. Arrange for chases, slots, and openings in other building components during progress of construction.
 4. Sequence, coordinate, and integrate installations of materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
 5. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 6. 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/Engineer.
 7. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
 8. Install 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. Extend grease fittings to an accessible location.
 9. Install access panel or doors where units are concealed behind finished surfaces.
 10. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
 11. Install materials and equipment firmly supported and secured to the building construction where required, and according to manufacturer's instructions.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 260010

SECTION 260030 - ELECTRICAL REQUIREMENTS FOR EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Condition and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This section specifies the basic requirements for electrical components for connection to equipment furnished under Division 26 and other Divisions of the Specifications. These components include, but are not limited to motors, starters, and disconnect switches. It also specifies Contractor responsibility for furnishing and/or installing various components.
- B. Specific electrical requirements (i.e. horsepower, kilowatts, and electrical characteristics) for mechanical and other equipment are scheduled on the Drawings or available from submittal (shop) drawings.

1.3 SUBMITTALS

- A. Product Data: Submit for each type of switch, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by UL or other testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.5 ELECTRICAL CONNECTIONS

- A. All electrical connections shall be made by the Electrical Contractor. Motors and controls for equipment furnished by each Contractor shall be furnished and set by the Contractor furnishing the equipment. Where electrical work is specifically indicated to be performed by the other Contractors, that Contractor shall perform the Work in conformance with the Electrical Specifications for this project.
- B. Motor connections: Flexible conduit, except where plug-in electrical cords are specifically indicated.

PART 2 - PRODUCTS

2.1 MOTORS

- A. The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements are specified in the individual equipment specifications or motor specification.
1. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.
 2. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range.
 3. 2-speed motors shall have two separate windings on poly-phase motors.
 4. Temperature Rating: Rated for 40 degrees C. environment with maximum 50°C temperature rise for continuous duty at full load (Class A Insulation).
 5. Starting capability: Frequency of starts as indicated by automatic control system, and not less than 5 evenly time spaced starts per hour for manually controlled motors.
 6. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors.

2.2 MOTOR STARTERS

A. Motor Starter Characteristics:

1. Enclosures: NEMA 1, general purpose enclosures with padlock ears, except in wet locations shall be NEMA 4 with conduit hubs, or units in hazardous locations which shall have NEC proper class and division.
2. Type and size of starter shall be as recommended by motor manufacturer and the driven equipment manufacturer for applicable protection and start-up condition.

B. Manual motor-starter switches:

1. Pilot lights and extra positions for multi-speed motors.
2. Overload protection: melting alloy type thermal overload relays.
3. Handle guard kit with padlock provision.

C. Magnetic Starters:

1. Maintained contact push buttons and pilot lights, properly arranged for single speed or multi-speed operation as indicated. Provide with H-O-A switch.
2. Trip-free thermal overload relays, each phase.
3. Interlocks, pneumatic switches and similar devices as required for coordination with control requirements of Temperature Controls sections.
4. Built-in 120 volts control circuit transformer, fused from line side, where service exceeds 120 volts.
5. Externally operated manual reset.
6. Under-voltage release or protection.
7. Hand-Off-Auto switch mounted on cover.

2.3 DISCONNECT SWITCHES

- A. General: Provide circuit and motor disconnect switches in types, sizes duties, features ratings, and enclosures as required or indicated. Provide NEMA 1 enclosure except for outdoor switches, and other indicated locations provide NEMA 4 enclosures with rain tight hubs. For motor and motor starter disconnects, provide units with horsepower ratings suitable to the loads.

- B. Fusible Switches: heavy duty switches, with fuses of classes and current ratings indicated. Where current limiting fuses are indicated, provide switches with non-interchangeable feature suitable only for current limiting type fuses.

- C. Non-fusible Disconnects: heavy duty switches of classes and current ratings as required or indicated.
- D. Electrical Interlocks: Provide number and arrangement of interlock contacts in switches when indicated.

2.4 COMBINATION MAGNETIC MOTOR STARTER/DISCONNECT

- A. Provide device with same features as magnetic motor starters and disconnect switches, in a common enclosure.

PART 3 - EXECUTION

3.1 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquid tight flexible conduit with watertight connectors in damp or wet locations.
- C. Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.
- D. Install disconnect switches, controllers, control stations, and control devices as indicated.
- E. Verify proper rotation of three phase equipment.
- F. Where applicable, extend power wire and conduit through external disconnect switches, combination starter/disconnect switches, magnetic or manual starters, thermal switches, local control switches, remote mounted control panels, etc. and connect to terminals in the equipment. Otherwise, extend power wire and conduit directly to equipment with integral control panel and single-point connection, and connect to terminals.
- G. Where indicated on the drawings, extend control wire and conduit between control switch and equipment.

3.2 ELECTRICAL COMPONENT RESPONSIBILITY

- A. The Contractor shall furnish all motors, starters, thermal overloads, push buttons for local and remote control, controllers, pressure switches, aquastats or similar items together with all appurtenances, accessories and control wiring required to operate the equipment furnished under the respective sections of the contract, and necessary to perform the operating functions as specified, shown on the drawings or as otherwise required.
- B. The Contractor shall set and mount all motors, starters and controls. The electrical sub-contractor shall, unless noted otherwise, furnish and install all safety switches at the equipment and make all power connections to the safety switches, starters and the motors. All control wiring necessary for the required performance and operation of the equipment shall be installed and connected under each respective and associated contract unless otherwise noted on drawing. Where the starter and/or safety switch is an integral part of the equipment assembly, the assembly shall be furnished with the wiring being complete between the starter, controller and motor and the Contractor shall make the power connections only at the unit.

- C. The electrical sub-contractor shall furnish, install and connect all power wiring to all equipment and all associated controls and appurtenances provided under this section of the contract, as well as install and connect all power wiring to all equipment, associated controls and appurtenances provided under other sections of this contract, unless otherwise specified herein or indicated on the drawings.

3.3 WIRING FOR HEATING, VENTILATING AND AIR CONDITIONING

- A. All equipment, unless otherwise indicated, for the heating, ventilating and air conditioning systems shall be furnished and installed under the mechanical (HVAC) sub-contract. The electrical sub-contractor shall however, be responsible for furnishing all labor and materials required for the installation and connection of all electrical power wiring to and for this equipment.
- B. In general, all starters and special control equipment required for the heating, ventilating and air conditioning equipment will be furnished and installed by the mechanical sub-contractor. Interlock and sequence control wiring for main heating and cooling equipment will be furnished and installed under the temperature control section of the mechanical sub-contract.
- C. All interconnecting control wiring in connection with the temperature control system for all heating and air conditioning systems shall be furnished, installed and connected under the mechanical sub-contract.
- D. The electrical sub-contractor shall provide a source of power and make final power connection at each rooftop unit, air handling unit, VAV box, and at each other apparatus control panel location where noted on the plans.

3.4 ELECTRICAL EQUIPMENT SPECIFIED IN OTHER DIVISIONS

- A. All electrical equipment specified in other Divisions shall be furnished with full complement of control equipment, control wiring, conduit and all other items necessary for satisfactory operation.
- B. The electrical sub-contractor shall furnish and install disconnect switches for all three phase equipment unless otherwise indicated.
- C. The electrical sub-contractor shall install thermal overload switches for each single phase motor except where units are furnished with built-in thermal protection, in which case furnish and install a single pole switch, with or without pilot light as require by drawings.
- D. The electrical sub-contractor shall complete all power wiring through the disconnect and/or the thermal cutouts and local control stations to the equipment as required.
- E. The electrical sub-contractor shall complete all electrical connections, through the disconnect, starter and motor terminals of all three phase equipment. The electrical sub-contractor shall be responsible for final connections.
- F. The electrical sub-contractor shall be responsible for proper rotation of three phase equipment.

END OF SECTION 260030

SECTION 260090 - REMOVALS AND DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This section includes requirements for demolition and removals of electrical systems and portions of the same.
- B. The Drawings are drawn to generally indicate the demolition required to accommodate the new construction but are not all-inclusive. The full extent of demolition work must be determined in the field based on the actual conditions encountered and as required for the satisfactory provision and proper execution of the work. It is the responsibility of the Contractor to coordinate the scope of work for each subcontractor.

1.3 DESCRIPTION OF WORK

- A. This Contractor shall be responsible for the removal of existing fixtures, wiring, conduit, supports, and equipment in the existing building which is noted or shown on the Drawings or which is in conflict with the new construction or new electrical systems. Remove all associated appurtenances such as hangers, sleeves, supports, and concrete pads. Remove all associated wiring back to its source. Existing equipment removed shall be disconnected at source and capped. Furnish all labor, equipment hauling, rigging, scaffolding, etc. necessary for the removal phase of the project.
- B. Where existing wiring, or equipment must be removed to install new systems and these systems must also remain operational because of phasing, the contractor shall provide temporary wiring and equipment for the remainder of the construction phasing.
- C. All electrical equipment to be removed must be disconnected by the Electrical Contractor.

1.4 SHUT-DOWNS

- A. Existing fixtures, equipment and related accessories which require systems to be shut-down shall be coordinated with the Owner. Periods of shut-down shall be minimal and all new work shall be planned and scheduled to accomplish as few shut-downs as possible.
- B. All construction and removal work shall be performed in a manner as to keep the existing systems in operation as the work progresses. Prior to commencing construction, the contractor shall review the construction schedule with the Owner and Architect to assure a well-coordinated schedule.

1.5 CUTTING AND PATCHING

- A. Cutting and patching shall be by this Contractor unless otherwise indicated. Patch existing wall, roof, and floor openings after removing electrical equipment, conduit and wiring. Patching shall match existing materials and methods of construction. Patching of floors, walls and roofs shall be performed in a manner to maintain structural integrity and to the satisfaction of the Architect. Patch and repair any spray on fire-proofing required because of removal of conduit, wiring, or equipment.

1.6 OWNERSHIP

- A. The Owner shall have the option of keeping any or all salvageable items removed from building such as lighting fixtures, panelboards, etc. Any items removed from the building that Owner does not wish to keep shall become the property of this Contractor and he shall recycle or dispose of these items in a legal landfill. Prior to removing any materials or equipment, the Contractor shall review with the Owner which materials or equipment the owner chooses to retain; the Contractor shall proceed to remove claimed equipment with extreme care so as not to damage the equipment or material.
- B. Provide notarized certification that disposal of materials resulting from demolition operations has been accomplished in conformance with all pertinent requirements and regulations of governmental agencies having jurisdiction. All cost for disposal shall be the responsibility of the contractor.
- C. All hazardous materials shall be disposed of in a legal manner that complies with EPA and DEP regulations. All cost for disposal shall be the responsibility of the contractor. Provide notarized certification that disposal of all hazardous materials has been accomplished in conformance with all pertinent requirements and regulations of governmental agencies having jurisdiction.

PART 2 - PRODUCTS: (Not Applicable)

PART 3 - EXECUTION

3.1 GENERAL

- A. Unless otherwise noted, Contractor shall be responsible for the demolition and removal of those existing materials and systems which would normally be handled and/or installed by the tradesman under jurisdiction of the Contractor. Furthermore, Contractor shall be responsible for the respective cutting, removal, patching, and repair of existing floors, walls, ceilings, roof construction, and site work.
- B. Should the contractor encounter a material, during the progress/demolition on this project they suspect may contain asbestos, and the material must be removed or penetrated to accommodate the new construction, the Contractor shall immediately notify the Owner and Architect in writing before any work on the material is performed. The Owner will have the material tested and have it removed if the test results warrant it.
- C. Materials resulting from demolition and removal operations shall become the property of the Contractor and shall be completely removed from the site unless noted otherwise on the drawings or requested by the Owner.
- D. Debris and other materials resulting from demolition operations shall not be permitted to be stored on site, unless noted otherwise.

- E. When an existing item is removed, the contractor shall also remove the accompanying sealant, supports, and all anchors. All sealant residue shall be completely removed and the walls cleaned and repaired to match adjacent wall surfaces.
- F. All extraneous items not required or needed in the renovated areas (i.e., dead thermostats, dead electric outlets, switches, conduits, abandoned wiring, floor outlets, etc.) shall be removed by the respective contractors and the surfaces patched to match the adjacent existing and/or new finishes.
- G. Contractor shall protect all floors, walls, ceilings, and furnishings throughout the demolition area. Any damage to the area as a result of demolition shall be fixed to match existing conditions at no extra cost to the Owner.
- H. Where equipment or wiring is removed, and holes or marked surfaces are left in the walls or ceiling they shall be patched to match the existing surface.

END OF SECTION 260090

SECTION 260519 - LOW-VOLTAGE POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
 - 3. Sleeves for cables.
- B. Related Sections include the following:
 - 1. Division 27 and 28 Sections for cabling used for fire alarm, communications, voice and data systems.

1.4 SUBMITTALS

- A. Submit product data for each type of product, indicating cable and accessory construction, materials and ratings.
- B. Submit manufacturer's installation instruction.
- C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use. Comply with NFPA 70.
- B. Conductor sizes based on copper. Aluminum conductors will not be accepted unless specifically noted.

1.6 COORDINATION

- A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- B. Wire and cable routing, if shown on Drawings, is approximate unless dimensioned. Route wire and cable as required to meet project conditions. Field verify all dimensions.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver wires and cables according to NEMA WC26.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Copper Conductors: Insulated soft-drawn copper conductors with dual-rated type THHN//THWN-2 600v insulation, to comply with NEMA WC 70, unless otherwise noted. Conductors shall be rated for 90 degrees C. wet or dry.
- B. Metal-Clad Cable: Comply with NEMA WC 70 for Type MC metal-clad multi-conductor cable, 600v insulated copper conductors, with full size insulated copper ground wire.
 - 1. MC Cable shall only be used where concealed in walls or above ceilings, except MC cable may be exposed in the Electrical Room where it connects to panelboard.

2.2 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SLEEVES FOR CABLES

- A. Steel Pipe Sleeves: Schedule 40, galvanized steel, ASTM A 53/A 53M Type E, Grade B, plain ends.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine raceways and building finishes to receive wires and cables for compliance with requirements for installation tolerances and other conditions affecting performance of wires and cables. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Verify that all conduits or raceways are clean and dry prior to installation of conductors or cables. If conduits or raceways are not clean and/or dry, clean and dry conduits or raceways prior to installation of new conductors or cables.

3.2 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders and Branch Circuits: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.3 CONDUCTOR INSULATION AND CABLE APPLICATIONS AND WIRING METHODS

- A. Feeders; Type THHN/THWN-2, single conductors in raceway.
- B. Branch Circuits: Type THHN/THWN-2, single conductors in raceway, or Type MC metal-clad cable.
 - 1. MC Cable shall only be used where concealed in walls or above ceilings, except MC cable may be exposed in the Electrical Room where it connects to panelboard.
- C. Class 1 Control Circuits: Type THHN/THWN-2 in raceway.
- D. Class 2 Control Circuits: Type THHN/THWN-2 in raceway, or power-limited cable where concealed in building finishes.

3.4 INSTALLATION OF CONDUCTORS AND CABLES

- A. Install conductors in conduit in areas of open structure. Exposed MC cables shall not be used in areas of open structure unless otherwise indicated. Conceal cables in finished walls or above ceilings.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
- C. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems". Identify each conductor with its circuit number or other designation indicated on drawings, at each end and in all pull boxes.

3.5 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B. Make terminations so there is no bare conductor at the terminal.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. .

3.6 FIELD QUALITY CONTROL

- A. Perform conductor tests and inspections and prepare test reports.
- B. Remove and replace malfunctioning conductors or cables and retest as specified above.

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. This Section includes methods and materials for grounding electrical systems and equipment.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 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. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: 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 B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 5. Bonding Conductor: 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: Rectangular bars of annealed copper, 1/4 by 2 inches in cross section by 10 inch length (minimum), with insulators and standoff brackets. Chatsworth Products No. 13622-010.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, solid or sectional type; 3/4 inch diameter by 96 inches in length unless otherwise indicated on the drawings.

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. Grounding Bus Bar: Install where indicated in electrical and telephone equipment rooms, in electrical rooms containing service equipment, and elsewhere as indicated.
- C. 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 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. Metal-clad cable runs.
- C. Signal and Communication Equipment: Refer to Section 27 11 00.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
 - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. 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 so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations or use a bolted clamp.
- D. Concrete-Encased Grounding Electrode: Fabricate according to NFPA 70, using 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 grounding grid or to grounding electrode external to concrete.

END OF SECTION 260526

SECTION 260530 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes hangers and supports for electrical equipment and systems.

1.2 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 70. Provide electrical components which are UL listed and labeled
- B. Comply with NECA “Standard of Installation” pertaining to anchors, fasteners, hangers, supports and mounting equipment.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Metallic Coatings: Hot-dip galvanized after fabrication.
 - 2. Painted Coatings: Manufacturer's standard painted coating.
 - 3. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

- F. 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. Verify suitability of fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick.
 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 in which used.
 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 6. Toggle Bolts: All-steel springhead type.
 7. Hanger Rods: Threaded steel.

2.2 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 Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
1. Secure raceways and cables to these supports with two-bolt conduit clamps, single-bolt conduit clamps or single-bolt conduit clamps using spring friction action for retention in support channel.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

- C. 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 Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 2. To Existing Concrete: Expansion anchor fasteners.
 3. 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.
 4. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts or Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69 or Spring-tension clamps.
 5. To Light Steel: Sheet metal screws.
 6. 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 meet anchorage requirements.

3.3 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.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 260530

SECTION 260533 – 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. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 SUBMITTALS

- A. Product Data: For conduits and fittings, surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, cabinets, and other products.

1.4 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. IMC: Intermediate metal conduit.
- D. LFMC: Liquidtight flexible metal conduit.
- E. RNC: Rigid nonmetallic conduit.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1.

- B. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit. Comply with NEMA RN 1, 0.040 inch minimum coating thickness
- C. Electrical Metallic Tubing: ANSI C80.3.
- D. Flexible Metal Conduit: Zinc-coated steel.
- E. Liquidtight Flexible Metal Conduit: Flexible steel conduit with PVC jacket.
- F. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 - 1. Fittings for EMT: Steel or die-cast, set-screw or compression type.
 - 2. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.
- G. Joint Compound for Rigid Steel Conduit: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. Rigid Nonmetallic Conduit (RNC): NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
- B. Liquidtight Flexible Nonmetallic Conduit (LFNC): UL 1660.
- C. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.
- D. Fittings for LFNC: UL 514B.

2.3 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

- A. Description: Comply with UL 2024; flexible type, approved for plenum, riser, or general-use as required by the installation.

2.4 METAL WIREWAYS

- A. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, 12, or 3R as required by the installation. Manufacturer's standard enamel finish.
- B. Fittings and Accessories: Include 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.
- C. Wireway Covers: Hinged type, Screw-cover type or flanged-and-gasketed type as indicated or required for application.

2.5 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Size and capacity as indicated. Manufacturer's standard enamel finish in color selected by Architect/Engineer.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Thomas & Betts Corporation.
 - b. Wiremold / Legrand.
 - c. Panduit
 - d. MonoSystems
 - e. Or approved equal

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, aluminum, Type FD, with gasketed cover.
- C. Metal Floor Boxes: Cast or sheet metal, fully adjustable, rectangular.
- D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- E. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum or galvanized, with gasketed cover.
- F. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
- G. Cabinets:
 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 2. Hinged door in front cover with flush latch and concealed hinge.
 3. Metal barriers to separate wiring of different systems and voltage.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. Description: Comply with SCTE 77.
 1. Color of Frame and Cover: Gray or Green.
 2. Configuration: Units shall be designed for flush burial and have open or integral closed bottom, as indicated.
 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 5. Cover Legend: Molded lettering, "ELECTRIC." or "TELEPHONE." as indicated for each service.
 6. Conduit Entrance Provisions: For integral closed-bottom units, provide conduit-terminating fittings to mate with entering ducts for secure, fixed installation in enclosure wall.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

- a. Armorcast Products Company.
- b. Carson Industries LLC.
- c. CDR Systems Corporation.
- d. NewBasis.
- e. Or approved equal

2.8 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. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.9 MECHANICAL SLEEVE SEALS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
 1. Advance Products & Systems, Inc.
 2. Calpico, Inc.
 3. Metraflex Co.
 4. Pipeline Seal and Insulator, Inc.
 5. Or approved equal
- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 2. Pressure Plates: Plastic, Include two for each sealing element.
 3. Connecting Bolts and Nuts: Carbon steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
 1. Exposed Conduit: Rigid steel conduit, or Rigid non-metallic conduit Type EPC-80-PVC where indicated.
 2. Concealed Conduit, Aboveground: Rigid steel conduit, or Intermediate metal conduit
 3. Underground Conduit: RNC, Type 80-PVC, direct buried.
 4. Connection to Vibrating Equipment (Including Transformers and Motor-Driven Equipment); Liquidtight flexible metal conduit
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R or 4.
 6. Application of Handholes and Boxes for Underground Wiring:

- a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
- b. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer-concrete units, SCTE 77, Tier 8 structural load rating.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed and Subject to Severe Physical Damage: Rigid steel conduit or IMC. Includes raceways in the following locations:
 - a. Loading docks.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms where installed from floor level up to 8 feet above floor.
3. Embedded in concrete slab or within slab-on-grade fill: Rigid nonmetallic conduit
4. Concealed above Ceilings and in Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: Rigid steel conduit.
7. Raceways for Optical Fiber or Communications Cable
 - a. Spaces Used for Environmental Air: Plenum-type, optical fiber/communications cable raceway or EMT.
 - b. Vertical Shafts: Riser-type, optical fiber/communications cable raceway or EMT.
 - c. Concealed General Purpose Distribution: General-use, optical fiber/communications cable raceway, Riser-type, optical fiber/communications cable raceway, Plenum-type, optical fiber/communications cable raceway, or EMT.
8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 in 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.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

3.2 RACEWAY INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- 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. Complete raceway installation before starting conductor installation. Use temporary closures to prevent foreign matter from entering raceway.

- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab. Protect stub-ups from damage where conduits rise through floor slabs.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Raceways Embedded in Slabs:
 - 1. Run RNC conduit parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Stub-up connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver operated, threaded flush plugs flush with floor for future equipment connections.
- I. 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.
- J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- K. 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.
- L. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
 - 1. 3/4-Inch (19-mm) Trade Size and Smaller: Install raceways in maximum lengths of 50 feet (15 m).
 - 2. 1-Inch (25-mm) Trade Size and Larger: Install raceways in maximum lengths of 75 feet (23 m).
 - 3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway 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.
- M. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where otherwise required by NFPA 70.
- N. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet.

1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
 - 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. Attics: 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 deg of temperature change.
 3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.
- O. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- P. 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.
- Q. Set floor boxes level and flush with finished floor surface. 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 Division 31 Section "Earth Moving" for pipe less than 6 inches in nominal diameter.
 2. Install backfill as specified in Division 31 Section "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.
 4. Install rigid steel conduit for all bends 45-degree and greater.
 5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
 - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally in trench a minimum of 36 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

- 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, set so cover surface will be flush with finished grade. In other areas, set covers of enclosures 1 inch above finished grade and taper same material as adjacent area to top of cover.
- D. Field-cut openings for conduits 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.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls. Coordinate locations with contractor installing slabs and walls.
- C. 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.
- D. Cut sleeves to length for mounting flush with both surfaces of walls.
- E. Extend sleeves installed in floors 2 inches above finished floor level.
- F. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed or unless seismic criteria require different clearance.
- G. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- H. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- I. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."
- J. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work. All products shall be compatible with roofing system and acceptable to roofing installer.
- K. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and sealant. Select sleeve size to allow for 1/4-inch annular clear space between conduit and sleeve for installing watertight sealant.
- L. Underground, Exterior-Wall Penetrations: Install cast-iron or galvanized sleeves. Size sleeves to allow for required annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground, exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping".

3.8 APPLICATIONS FOR BOXES, CABINETS AND ENCLOSURES

- A. Cabinets: Flush mounted, NEMA enclosure type 1 except otherwise indicated.
- B. Hinged Door Enclosures: NEMA type 12 enclosure except as indicated.
- C. Hinged Door Enclosures Outdoors: Install drip hood, factory tailored to individual units.
- D. Outlet Boxes and Fittings: Install outlet and device boxes and associated covers and fittings of materials and NEMA types suitable for each location and in conformance with the following requirements.
 - 1. Interior Dry Locations: Sheet steel, NEMA type 1.
 - 2. Locations Exposed to Weather or Dampness: Cast metal, NEMA type 3.
 - 3. Locations Exposed to Weather or Dampness: Molded PVC or glass fiber reinforced plastic, NEMA type 3R.
 - 4. Wet locations: NEMA type 4 enclosures.
- E. Pull and Junction Boxes: Install pull and junction boxes of materials and NEMA types suitable for each location except as otherwise indicated.
- F. Floor boxes: In slabs on grade and wet locations use NEMA type 4 boxes. At other locations in slabs, use concrete-tight NEMA 1 boxes. Contractor shall verify floor construction and verify adequate thickness to accommodate floor box.
- G. Carpet/Tile Flange: Coordinate style flange with General Contractor and/or Architect.

3.9 INSTALLATION OF OUTLET BOXES

- A. Outlet Boxes at Windows and Doors: Locate close to window trim. For outlets indicated above doors, use 12" mounting height above finished above the door opening except as otherwise indicated.
- B. Column and Pilaster Locations: Locate outlet boxes for switches and receptacles on columns or pilasters so the centers of the columns are clear for future installation of partitions.
- C. Locations in Special Finish Materials: For outlet boxes for receptacles and switches mounted in desks or furniture cabinets or in glazed tile, concrete block, marble, brick, stone or wood walls, use rectangular

shaped boxes with square corners and straight sides. Install such boxes without plaster rings. Saw cut all recesses for outlet boxes in exposed masonry walls.

- D. Gasketed boxes: At the following locations use cast metal, threaded hub boxes with gasketed weatherproof covers.
 - 1. Exterior locations.
 - 2. Where surface mounted on unfinished walls, columns or pilasters (Cover gaskets may be omitted in dry locations).
 - 3. Where exposed to moisture laden atmosphere.
 - 4. At food preparation equipment within four feet of steam connections.
 - 5. Where indicated.
- E. Cast-Iron Boxes: Iron alloy, waterproof, with threaded raceway entries and features and accessories suitable for each location, including mounting ears, threaded screw holes for devices and closure plugs.
- F. Mounting: Mount outlet boxes for switches with the long access vertical or as indicated. Mount boxes for receptacles either vertically or horizontally but consistently either way. Three or more gang boxes shall be mounted with the long axis horizontal. Locate box covers or device plates so they will not span different types of building finishes either vertically or horizontally. Locate boxes for switches near doors on the side opposite the hinges and close to door trim, even though electrical floor plans may show them on hinge side.
- G. Ceiling Outlets: For fixtures, where wiring is concealed, use outlet boxes 4 inches square by 1 ½ inches deep minimum.
- H. Cover Plates for Surface Boxes: Use plates sized to box front without overlap.
- I. Protect outlet boxes to prevent entrance of plaster, and debris. Thoroughly clean foreign material from boxes before conductors are installed.
- J. Concrete Boxes: Saw cut opening for box in center of of masonry block cell. Coordinate with masonry installer. Use extra deep boxes to permit side conduit entrance without interfering with reinforcing, but do not use such boxes with over 6-inch depth.
- K. Floor Boxes: Install in concrete floor slabs so they are completely enveloped in concrete except for the top. Where normal slab thickness will not envelop box as specified above, provide increased thickness of the slab below box; coordinate with floor slab installer. Provide each compartment of each floor box with grounding terminal consisting of a washer-in-head machine screw, not smaller than no. 10-32, screwed into a tapped hole in the box. Adjust covers of floor boxes flush with finished floor.

3.10 INSTALLATION OF PULL AND JUNCTION BOXES, CABINETS AND ENCLOSURES

- A. Box Selection: For boxes in main feeder conduit runs, use sizes not smaller than 8 inches square by 4 inches deep. Do not exceed 6 entering and 6 leaving raceways in a single box. Quantities of conductors (including equipment grounding conductors) in pull or junction box shall not exceed the following:

<u>Size of Largest Conductors in Box</u>	<u>Maximum no. of Conductors in Box</u>
No. 4/0 AWG	30
250MCM	20
500MCM	15
Over 500 MCM	10

1. Cable supports: Install clamps, grids or devices to which cables may be secured. Arrange cables so they may be readily identified. Support cable at least every 30 inches inside boxes.
- B. For pull boxes in inaccessible ceilings, mount with the covers flush with the finished ceiling.
- C. In finished spaces, set flush with walls.
- D. Size: Provide pull and junction boxes for telephone, signal and other systems at least 50% larger than would be required by Article 370 of NEC, or as indicated. Locate boxes strategically and provide shapes to permit easy pulling of future wires or cables of types normal for such systems.
- E. Mount with fronts straight and plumb.
- F. Install with tops 78 inches above floor.

4.2 CLEANING

- A. On completion of installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt and construction debris and repair damaged finish, including chips scratches, and abrasions.

4.3 GROUNDING

- A. Electrically ground metallic cabinets, boxes, and enclosures. Where wiring to item includes a grounding conductor, provide a grounding terminal in the interior of the cabinet, box or enclosure.

4.4 IDENTIFICATION

- A. Every concealed cabinet, pull box, junction box or enclosure shall have identification label on exterior cover indicating equipment, feeder circuit or other device installed within or connected through enclosure.
- B. Every box exposed to view in finished spaces shall have same information listed on inside of box cover.

END OF SECTION 260533

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Identification for raceway and metal-clad cable.
 - 2. Identification for conductors and communication and control cable.
 - 3. Warning labels and signs.
 - 4. Equipment labels.

1.2 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Identification Schedule: A list of nomenclature for electrical equipment and system components identification signs and labels.

1.3 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes and standards. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Install identifying devices before installing acoustical ceilings and similar concealment. Coordinate installation of identifying devices with location of access panels and doors.

PART 2 - PRODUCTS

2.1 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Snap-Around Labels: Slit, pre-tensioned, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

2.2 ADHESIVE LABELS

- A. Self-Adhesive Vinyl Labels: Machine-printed, flexible label laminated with a clear, weather- and chemical-resistant coating and adhesive tape, 1/4" high black letters

2.3 CONDUCTOR AND CABLE IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.4 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on inside of front cover, door, or other access to equipment, unless otherwise indicated.
- C. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES "

2.5 EQUIPMENT IDENTIFICATION LABELS

- A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Type 6/6 nylon cable ties, self-extinguishing, 1-piece, self-locking,
- 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 APPLICATION

- A. Power-Circuit Conductor Identification: For conductors in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape and wraparound marker labels. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.

- B. Branch-Circuit Conductor Identification: Identify conductors for branch circuits in junction, pull boxes and panel board gutters. Identify each ungrounded conductor according to source and circuit number using wraparound marker labels.
- C. Conductors to Be Extended in the Future: Attach marker labels-on tags to conductors and list source and circuit number.
- D. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.
- E. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
 - 1. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
- F. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:
 - a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where 2 lines of text are required, use labels 2 inches high. Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - 2. Examples of equipment to be labeled:
 - a. Panelboards, electrical cabinets, and enclosures.
 - b. Contactors, motor starters, motor-control centers.
 - c. Disconnect switches, enclosed circuit breakers.
 - d. Duct Detector remote test switches
- G. Adhesive Labels: Install self-adhesive tape label to identify the following:
 - 1. source panelboard and circuit number on receptacle cover plate
 - 2. Outlet jacks, and patch panels for voice and data communications systems.

3.2 INSTALLATION

- A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

- B. Apply identification devices to surfaces that require finish, after completing finish work.
- C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- D. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Locate bands at changes in direction, at penetrations of walls and floors, at 30-foot maximum intervals in straight runs, and at 15-foot maximum intervals in congested areas.
- E. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the 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. 10 AWG if authorities having jurisdiction permit,
 - 2. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - d. Neutral: Gray.
 - 3. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - d. Neutral: White.
 - 4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

END OF SECTION 260553

SECTION 260945 - LIGHTING CONTROL SYSTEM

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 a Digital Lighting Management System for sensor-based control of interior and time-based control of exterior lighting fixtures.
- B. The system shall be capable of turning interconnected lighting loads on/off, as well as dimming lights where dimming capability is specified. All system devices shall be individually addressable, with designated devices networked together.
- C. Related Sections include the following:
 - 1. Division 27 Communications Cabling sections.

1.3 REFERENCES

- A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE)
- B. National Electrical Manufacturers Association (NEMA)
- C. Underwriters Laboratories, Inc. (UL508 – Industrial Control Equipment)

1.4 SYSTEM DESCRIPTION & OPERATION

- A. The Lighting Control and Automation system as defined under this section covers the following equipment:
 - 1. Room Power Packs: provide with 0-10v dimming where indicated.
 - 2. Occupancy/Vacancy Sensors: Auto adjusting, MicroSet technology, NEMA WD7 compliant occupancy/vacancy sensors.
 - 3. Wallstations: Smart control device that is pre-configured, with pre-engraved digital pushbuttons, either manual (toggle) style, or toggle style with dimming adjustment.
 - 4. Control Communication Cable: Pre-defined lengths of quick connect plenum rated cable (RJ45) for power and data to smart devices. Cable color shall be unique (green) to differentiate from other communications systems.
 - 5. Relay control panel for exterior lighting control.
 - 6. Outdoor photocell for daylight sensing, and photocell interface for exterior lighting control.
 - 7. Indoor photocell for daylight sensing and dimming control of interior lighting.

1.5 LIGHTING CONTROL FUNCTIONS

- A. General: Provide the following lighting control capabilities:
 - 1. Occupancy/Vacancy requirements – Provide occupancy sensors with Automatic On/ Automatic Off functionality and vacancy sensors with Manual On/Automatic Off functionality as shown.
- B. Space Control Descriptions. Refer to drawings for locations where specific control method and quantity of control devices are required:
 - 1. Spaces with dimming controls:
 - a. Ceiling mounted occupancy/vacancy sensor(s) – automatically turns off all room lights after room is unoccupied, per adjustable time delay.
 - b. Low voltage wall station with raise/lower 0-10v dimming allows user to manually turn lights on/off and adjust light level, interconnected with occupancy/vacancy sensor.
 - 2. Spaces without dimming controls:
 - a. Ceiling occupancy/vacancy sensor(s) automatically turns off all room lights after room is unoccupied, per adjustable time delay. Low voltage wall station allows user to manually control lights on/off.
 - b. Wall mounted occupancy/vacancy sensor(s) with manual override; automatically turns off all room lights after room is unoccupied, per adjustable time delay. Override button (on wall mounted sensors only) allows user to manually control lights on/off.

1.6 PERFORMANCE REQUIREMENTS

- A. The Lighting Control System shall include: the power pack, wallstations, matching color screwless wallplates, occupancy/vacancy sensors, daylight sensors, quick connect cable (plenum rated).

1.7 SUBMITTALS

- A. Shop Drawings:
 - 1. Composite wiring and/or schematic diagram of each control circuit, as proposed, to be installed (standard diagrams will not be accepted).
 - 2. Scale floor plan drawing for each space showing exact location of each sensor, room controller and digital switch. AutoCAD (.dwg) files will be furnished by the Architect/Engineer for the system vendor's use in preparing shop drawings.
- B. Product Data: Catalog sheets, specifications and installation instructions.
- C. Warranties: Standard and special warranty information.

1.8 QUALITY ASSURANCE

- A. Products: All electrical components and devices shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency and marked for intended use.
- B. Comply with NFPA 70.

1.9 PROJECT CONDITIONS

A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:

1. Ambient temperature: 32° to 104° F
2. Relative humidity: Maximum 90 percent, non-condensing

1.10 WARRANTY

A. Manufacturer shall supply a 5-year warranty on all materials, hardware and software. These warranties will be in effect for all installations.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

1. Hubbell Control Solutions NX (basis-of-design)
2. nLight Network Control System by Sensor Switch, an Acuity Brands Company
3. Cooper Controls

B. Refer to lighting control details on the drawings for required products and part numbers.

2.2 WALL OR CEILING MOUNTED OCCUPANCY/VACANCY PERFORMANCE REQUIREMENTS

A. Sensing mechanism:

1. Dual technology:

- a. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
- b. Incorporate Passive Dual Technology (PDT) to sense motion and sounds.

B. Power failure memory:

1. Controls incorporate non-volatile memory. Should power be interrupted and subsequently restored, settings and parameters saved in protected memory shall not be lost.

C. Sensor shall have time delays from 10 to 30 min.

D. When specified, sensors shall automatically adjust time delay and sensitivity settings.

E. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.

F. All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.

2.3 CEILING MOUNTED SENSORS

- A. Provide all necessary mounting hardware and instructions.
- B. Sensors shall be Class 2 devices.
- C. Connect to other components via quick-connect cable to eliminate wiring errors.
 - 1. Occupancy Sensor and Daylight sensor shall be connected using a daisy chain connection to the Room Controller.
- D. Device calibration and features:
 - 1. Sensitivity – 0-100% in 10% increments.
 - 2. Time delay – 1-30, self-adjusts to 10 min based on room occupancy.
 - 3. Test mode – Fifteen second time delay.
 - 4. Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
 - 5. Walk-through mode.
 - 6. Ultrasonic and Dual Technology Sensors utilize two independent sensor detection circuits simultaneously to ensure optimum performance, regardless of location or proximity to walls and structures.
 - 7. Automatically and continually self-adjust ultrasonic frequency to ignore specific frequency, continuous noise from airflow to prevent detuning which can lead to inadvertent lights out. Sensors that require detuning shall not be acceptable.
 - 8. All load parameters including Automatic On/Manual On, blink warning and daylight enable/disable when daylight sensors are pre-defined with the Room Controller local network.
- E. Device Status LEDs including:
 - 1. PIR Detection
 - 2. Ultrasonic detection
- F. Occupancy sensors are pre-defined to specific loads within the room without wiring or special tools for maximum energy savings.
- G. Manual override of controlled loads.
- H. Multiple occupancy sensors may be installed in a room by simply daisy-chaining them together to the Room Controller via Click & Go cable. No additional configuration will be required

2.4 WALL/CORNER MOUNTED SENSORS

- A. Provide all necessary mounting hardware and instructions.
- B. Sensors shall be Class 2 devices.
- C. Connect to another component via quick-connect cable to eliminate wiring errors.
 - 1. OCC-RJ45 Room Controller accessory is used to allow any standard occupancy/vacancy sensor to utilize quick-connect cable connections.
 - 2. Two RJ45 connection ports for connection to Room Controller.
 - 2. Occupancy Sensor and Daylight sensor shall be connected using a daisy-chain connection to the Room Controller.

- D. Device calibration and features:
1. Sensitivity – 0-100% in 10% increments.
 2. Time delay – 1-30, self-adjusts to 10 min. based on room occupancy.
 3. Test Mode – Fifteen second time delay.
 4. Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
 5. Walk-Through Mode.
 6. Automatically and continually self-adjust ultrasonic frequency to ignore specific frequency continuous noise from airflow to prevent detuning which can lead to inadvertent lights out. Sensors that require detuning shall not be acceptable.
 7. All load parameters including Automatic On/Manual ON, blink warning, and daylight enable/disable when daylight sensors are pre-defined with the Room Controller local network.
- E. Device Status LEDs including:
1. PIR Detection
 2. Ultrasonic detection
- F. Occupancy sensors are pre-defined to specific loads within the room without wiring or special tools for maximum energy savings.
- G. Manual override of controlled loads.
- H. Multiple occupancy sensors may be installed in a room using a daisy chain quick-connect cable to the Room Controller. No additional configuration will be required

2.5 WALLSTATIONS

- A. Low voltage momentary pushbutton switches in 2, 3, 4, 5 and 6 button configuration; available in white, ivory, grey and black; compatible with wall plates with decorator opening. Wallstations shall include the following features:
1. Removable buttons for field replacement with engraved buttons. Button replacement may be completed without removing the switch from the wall.
 2. Intuitive button labeling to match application and load controls.
 3. Pre-defined digital button configurations. Each wallstation is shipped with pre-defined digital button configurations which are automatically sensed by the connected Room Controller and mapped to specific load controls for immediate out of the box functionality.
- B. Two RJ-45 ports for connection to other system components.
- C. Multiple digital wallstations may be installed in a room by connecting them to the local lighting system control network. No additional configuration will be required to achieve multi-way switching.
- D. Digital wallstations are delivered with pre-defined functions including, raise, lower, A/V Mode, Quiet Time, manual and scene control. No additional configuration is required to provide a fully functional system. Systems that require configuration or load binding and do not deliver maximum energy savings out of the box shall not be acceptable.

2.6 DAYLIGHT PHOTOSENSORS/ IR RECEIVER

- A. Daylight photosensors work with Room Controllers to provide automatic daylight switching capabilities for any load type connected to a room controller. Open loop daylight sensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones. Daylight sensors shall be interchangeable without the need for rewiring. Daylight sensors shall be capable of daisy-chaining with occupancy sensors in each room.

- B. Digital daylight sensors include the following features:
 - 1. An internal photodiode that measures only within the visible spectrum and has a response curve that closely matches the photopic curve.
 - 2. The daylight sensor has three light level ranges: Low (3-300 lux), High (30-3000 lux), and Direct Sun (300-30000 lux).
 - 3. Optional digital wallstations to allow occupants to reduce lighting level to increase energy savings and lower lighting levels for a selected period of time or cycle of occupancy.
 - 4. Infrared (IR) transceiver for daylight sensor range and daylight zone gain adjustments via handheld remote programmer.
 - 5. Infrared (IR) receiver for personal control and scene programming via handheld remote programmer.
 - 6. Red configuration LED that blinks to indicate data transmission.
 - 7. Green Mode status LED that blinks to indicate Daylight Commissioning Mode.
 - 8. Green Mode status LED that remains constant ON when daylight range is set to low for available natural light.
 - 9. RJ45 ports for connection to lighting control network.
 - 10. An adjustable head and an optional mounting bracket to accommodate multiple mounting methods and building materials. The daylight sensor may be mounted on a ceiling tile, skylight well, suspended lighting fixture or backbox.

- C. Open loop digital daylight sensor includes the following additional features:
 - 1. An internal photodiode that measures light in a 60 degree angle cutting off the unwanted light from the interior of the room.

2.7 LIGHTING CONTROL NETWORK AND CABLING

- A. The lighting control network is a physical connection and communication protocol designed to optimally control a space within a building. Control devices connect to the lighting control network using Category 5e or 6 green jacketed cables with RJ45 QuickConnect cables which provide both data and power to room devices. Features of the network include:
 - 1. Click & Go default functionality of occupancy sensors, wallstations, slider station, daylight sensors, receptacle controls, BMS status output and lighting loads to the most energy-efficient sequence of operation based upon the device attached.
 - 2. Replacement of any device in the network with a standard off the shelf unit without requiring commissioning, configuration or setup.

2.8 SYSTEM POWER PACKS

- A. Power Pack shall incorporate one or more Class 1 relays and contribute low voltage power to the rest of the system. Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All devices shall have two RJ-45 ports
 - 1. Power Packs shall accept 120 or 277 VAC, be plenum rated, and provide Class 2 power to the system.

2. Power Pack parameters shall be available and configurable remotely from the software and locally via the device push-button.
 3. Power Pack shall securely mount to junction location through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast channel. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads.
- B. Secondary Packs shall incorporate the relay(s), shall have a second relay, 0-10 VDC dimming output, or line voltage dimming output, but shall not be required to contribute system power.
1. Secondary Packs shall be available that provide up to 16 Amp switching of all lighting loads
 2. Secondary Packs shall be available that provide up to 5 Amps switching of all lighting load types as well as 0-10 VDC dimming or fluorescent ballasts/LED drivers
 3. Secondary Packs shall be available that provide up to 5 Amps of switching as well as 0-10 VDC dimming of fluorescent ballasts/LED drivers.
 4. Secondary Packs are UL924 listed for switching of Emergency Power circuits
- C. Power Supplies shall provide system power only, but are not required to switch line voltage circuit. Auxiliary Relay Packs shall switch low voltage circuits only.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. The control system shall be installed and fully wired as shown on the plans by the installing contractor. The contractor shall complete all electrical connections to all control circuits.
- B. All low voltage smart devices shall connect using quick-connect cable provided by the system manufacturer. When using wire for connections other than manufacturer-furnished quick-connect low voltage wire (pre-defined lengths of RJ45 cable), provide detailed point to point wiring diagrams for every termination. Provide wire specifications and wire colors to simplify termination requirements.
- C. Install the wiring specified in this Section in accordance with manufacturer's printed instructions, with Division 27 sections.
- D. Provide written or computer-generated documentation on the commissioning of the system including room by room description including:
1. Sensor parameters, time delays, sensitivities and daylighting setpoints.
 2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.).
 3. Load parameters (e.g. blink warning, etc.).

3.2 STARTUP, COMMISSIONING AND TRAINING

- A. Upon completion of the installation, the system shall be commissioned by the manufacturer's factory authorized representative who will verify a complete fully functional system.
- B. Provide written notice of the system startup and adjustment date to the Architect/Engineer and to schedule initial training session with Owner.

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- C. Upon completion of the system commissioning the factory-authorized technician shall provide training to the owner's personnel on the adjustment and maintenance of the system. Include (two) two-hour sessions, one at completion of project and one approximately one month after occupancy for followup adjustments and re-training.

END OF SECTION 260945

SECTION 262100 – ELECTRICAL DISTRIBUTION 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. Lighting and appliance branch-circuit panelboards.

1.3 SUBMITTALS

- A. Product Data: For each specified product, accessory, and component indicated. 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. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
- C. Field Quality-Control Test Reports.
- D. Operation and Maintenance Data

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain all similar components and accessories from single manufacturer where available.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between equipment 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 a qualified testing agency, and marked for intended location and application.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and shipping materials from inside equipment. Handle and prepare equipment for installation according to manufacturer's instructions.
- B. Store in clean, dry environment. Maintain in factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris, and traffic.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install equipment until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and ambient temperature and humidity conditions are at occupancy levels for the remainder of the construction period.

1.7 COORDINATION

- A. Coordinate layout and installation of equipment and other components with other construction, including electrical and other types of equipment, raceways, piping, obstructions to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels to allow complete swing and/or removal.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Subject to the compliance with these specifications, the following manufacturers may offer specified or equivalent products:
 - 1. Panelboards and Accessories:
 - a. Square D Company (Basis of Design)
 - b. Eaton Corp.; Cutler-Hammer Products.
 - c. General Electric Co.; Electrical Distribution & Control Div.
 - d. Siemens Energy & Automation, Inc.
- B. Phase, Neutral, and Ground Buses:
 - 1. Material: Tin-plated aluminum.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- C. Conductor Connectors: Compression type suitable for use with copper or aluminum conductor material and sizes.
 - 1. Material: Tin-plated aluminum.
 - 2. Main and Neutral Lugs: Top or bottom as Installer's option
 - 3. Ground Lugs: Compression type, suitable for use with copper or aluminum conductor material.
- D. Service Equipment Label: NRTL labeled for use where indicated as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

- E. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- F. Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by an NRTL.

2.2 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- B. Panelboard Enclosures:
 - 1. Refer to schedules for cabinet mounting style. Cabinets shall be rated for environmental conditions as scheduled or required by location.
 - a. Indoor Dry and Clean Locations: Type 1
 - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 3. Finishes:
 - a. Panels and Trim: Steel factory finished immediately after cleaning and pre-treating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel for recessed mounting and surface mounting in unfinished spaces. Same painted finish as panel front and trim for surface mounting in finished spaces or for Type 3R cabinets.
 - 4. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
 - 5. Provide four (4) extra keys for each style lock.
- C. Mains: Circuit breaker or lugs only. Refer to panel schedules on drawings.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.3 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with series-connected rating to meet available fault currents. Provide type and trip ratings as scheduled.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

4. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: with mechanical connectors for copper feeders and branch-circuit ground conductors, or compression connectors for aluminum feeders; style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type HACR-rated for use on refrigeration equipment circuits, Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
 - f. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in 'on' or 'off' position.
 - g. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.4 DISCONNECT SWITCHES

- A. General: Provide circuit and motor disconnect switches in types, sizes duties, features ratings, and enclosures as required or indicated. For motor and motor starter disconnects, provide units with horsepower ratings suitable to the loads.
 1. Provide NEMA 1 enclosure except for outdoor switches, and other indicated locations.
 2. Provide NEMA 4 enclosures with rain tight hubs.
Fusible Switches: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
 3. Fuses: Provide type and rating indicated, with fuses of classes and current ratings indicated. Where current limiting fuses are indicated, provide switches with non-interchangeable feature suitable only for current limiting type fuse.
- B. Non-fusible Disconnects: heavy duty switches of classes and current ratings as required or indicated.
- C. Electrical Interlocks: Provide number and arrangement of interlock contacts in switches when indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation
- B. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PANELBOARDS

- A. Install panelboards and accessories according to manufacturer's instructions and NEMA PB 1.1.

- B. Mounting: Install panelboards using anchorage devices appropriate for the substrate. Mount top of trim a maximum of 90 inches above finished floor, unless otherwise indicated. The operating handle of top-most switch or circuit breaker, in 'on' position, shall not exceed 79 inches above finished floor or grade.
 - 1. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- C. Install overcurrent protective devices not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
 - 2. Install filler plates in unused spaces
- D. Spare conduits: In addition to the specified quantity of circuit conduits, provide the following spare conduit provisions at each recessed panelboard:
 - 1. Four 1-inch empty conduits from panelboard into accessible ceiling space or at underside of exposed structure or floor/roof deck above.
 - 2. Two 1-inch empty conduits into ceiling space of floor below. Not required for slab on grade locations.
- E. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.3 IDENTIFICATION

- A. Identify field-installed conductors and components. Provide labels, signs and products complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a circuit directory to indicate installed circuit loads after balancing loads; incorporate Owner's final room designations.
 - 1. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Nameplates: Label each equipment cover with an engraved laminate nameplate with 3/8 inch lettering, white letters on a black background (normal power) or red background (emergency power). Use panel designation referenced on the drawings.
- D. Circuit Breaker Nameplates: Label each branch circuit breaker in distribution panelboards with an engraved laminate nameplate, 1/4 inch high white letters.

3.4 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification for each piece of equipment.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- B. Equipment will be considered defective if it does not pass tests and inspections.

- C. Prepare test and inspection reports, including a certified report that identifies equipment was tested and that describes deficiencies detected, remedial action taken and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly.
- B. Set field-adjustable circuit-breaker trip ranges as indicated.
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows.
 - 1. Measure as directed during period of normal system loading. Perform phase load-balancing circuit changes outside normal occupancy/working schedule of the facility.
 - 2. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 - 3. Tolerance: Difference exceeding 10 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 PROTECTION

- A. Protect installed equipment from damage, paint, moisture, dirt and dust during remainder of construction period.

3.7 CLEANING

- A. On completion of installation, inspect interior and exterior of equipment. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 262100

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles
 - 2. Switches and wall-box dimmers.
 - 3. Device cover plates
- B. Refer to related Section 26 04 95 Lighting Control System

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.4 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. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 STRAIGHT BLADE RECEPTACLES

- A. Duplex Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 - 1. Basis-of-Design: Pass & Seymour CRB 5362

2. Other manufacturers who may offer equal products include the following:

- a. Cooper
- b. Hubbell
- c. Leviton
- d. Or approved equal

2.2 GFCI RECEPTACLES

A. General Description: Straight blade, non-feed-through-type. Comply with NEMA WD 1, NEMA WD 6, UL 498, Federal Specification WC596, and UL943, Class A. Include indicator light that is lighted when device is tripped. Must have self-test feature (conducts an automatic test every three seconds, ensuring ground fault protection). If ground fault protection is compromised, power to the receptacle must be discontinued.

B. Duplex GFCI Receptacles, NEMA 5-20R, 125 V, 20 A:

1. Basis-of-Design: Pass & Seymour; 2097
2. Other manufacturers who may offer equal products include the following:
 - a. Cooper
 - b. Hubbell
 - c. Leviton
 - d. Or approved equal

2.3 SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 amp, specification grade commercial duty, back and side wired.

1. Basis-of-Design: Pass & Seymour; CSB20AC1 (single pole), CSB20AC2 (two pole), CSB20AC3 (three way), CSB20AC4 (four way).
2. Other manufacturers who may offer equal products include the following:
 - a. Cooper
 - b. Hubbell
 - c. Leviton
 - d. Or approved equal

2.4 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035-inch thick, satin-finished stainless steel

2.5 FINISHES

- A. Color: Wiring Devices Connected to Normal Power System: Brown, Ivory, or White as selected by Architect.

2.6 FLOOR BOXES

- A. Refer to drawings for in-floor boxes, including wiring devices and mounting provisions for communications devices and cables.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 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 just 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 meet provisions of 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. Pigtailing existing conductors is permitted provided the outlet box is large enough.
- D. Device Installation:
1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
 6. Use a torque screwdriver when a torque is recommended or required by the 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 left.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black on light and white on dark lettering on face of plate, and durable wire markers or tags on conductors inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Ground Impedance: Values of up to 2 ohms are acceptable.
3. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
4. Using the test plug, verify that the device and its outlet box are securely mounted.
5. The 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.

3.4 CLEANING

A. Clean devices, device outlet boxes and enclosures. Replace stained or improperly painted wall plates on devices.

END OF SECTION 262726

SECTION 265100 - LIGHTING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Interior lighting fixtures
 - 2. Exit fixtures
 - 3. Integral battery powered drivers for emergency operation
 - 4. Lighting fixture supports and accessories.

1.2 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of lighting fixture including dimensions.
 - 2. Life, output, and energy-efficiency data for LED driver and light source.
 - 3. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with LED drivers and accessories identical to those indicated for the lighting fixture as applied in this Project.
- B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
- C. Maintenance Data: Submit maintenance data and parts list for each luminaire and accessory; including product data, and shop drawings in accordance with requirements of Division 1.

1.3 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by UL or other testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.4 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.5 DELIVERY AND STORAGE

- A. Deliver luminaires in factory-fabricated containers or wrappings, which properly protect luminaires from damage. Handle luminaires carefully to prevent damage, breaking and scoring of finishes. Do not install damaged units or components; replace with new.
- B. Store luminaires in original packaging. Store inside well ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity, laid flat and blocked off ground.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Design and specification is based on the manufacturers' products noted or scheduled on drawings. Subject to the compliance with these specifications and Architect/Engineer approval, other manufacturers may provide equivalent products.
 - 1. The Architect/Engineer reserves the right to reject any submitted products which do not meet the same level of quality, photometric performance, energy efficiency, finish, aesthetic qualities, features, or other criteria as determined by the A/E to be not acceptable. The Architect/Engineer reserves the right to request samples of alternate manufacturers' products prior to completing review of fixture submittal. Samples shall be delivered to the designated location for review at no cost to the Owner or Architect/Engineer.
 - 2. Refer to schedules on Drawings for specified manufacturers' products and model numbers.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- A. General: Provide luminaires, of sizes, types and ratings indicated; complete with housing, LED drivers and light boards, reflectors, trim, accessories and wiring.
- B. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- C. Fixtures: Comply with UL 1598.
- D. Internal Battery Unit: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with LED driver. Comply with UL 924.
 - 1. Emergency Connection: Operate LED engine at a reduced lumen output, output varies per scheduled fixture and model number. Wire an un-switched circuit connection to battery-inverter unit and a switched circuit connection to fixture ballast, unless otherwise noted on the drawings.
 - 2. Test Push Button and Indicator Light: Visible and accessible without opening fixture 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.
 - 3. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - 4. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.

2.3 LED LIGHTING

- A. LED Light Engine: Light engine shall utilize remote phosphor lens and mixing chamber to ensure perfectly mixed light, resulting in uniform colors and superior color consistency from fixture to fixture. Provide 2700K, 3000K, 3500K and 4100K color temperatures as scheduled or selected by Architect/Engineer. CRI shall be greater than 80. Cast aluminum heat sink integrated directly with housing provides thermal management. LEDs shall operate below manufacturer's published junction temperature to ensure attainment of rated life of the LEDs . Light engine shall mount directly to heat sink and be easily replaceable.
- B. LED Driver: Universal driver accommodates 120V to 277V input volts AC at 50/60Hz . Power factor shall be greater than 0.9. Unit shall be easily replaceable from above or below the ceiling. Rated life shall be a minimum of 50,000 hours at 70% lumen maintenance.
 - 1. Dimming: Where scheduled, driver shall be dimmable via 0-10V protocol, increasing efficiency up to 30% while dimming.

2.4 EXIT SIGNS

- A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 - 1. Lamps for AC Operation: strip-type LEDs, 70,000 hours minimum rated lamp life.
- C. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - 1. Battery: Sealed, maintenance-free, nickel-cadmium type, capacity as scheduled.
 - 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - 3. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - 4. Provide unit-mounted lamp head where indicated
 - 5. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - 6. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.5 EMERGENCY LIGHTING UNITS

- A. Description: Self-contained units complying with UL 924.
 - 1. Battery: Sealed, maintenance-free, lead-acid type.
 - 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - 3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - 4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

5. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install per manufacturer's instructions. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.
 1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from lighting fixture corners.
 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
 4. Install two support rods or wires from structure and attach directly to lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- C. Suspended Lighting Fixture Support:
 1. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 2. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
- D. Install flush mounted luminaires properly to eliminate light leakage between luminaire frame and finished surface.
- E. Provide plaster frames for recessed luminaires installed in other than suspended grid type acoustical ceiling systems. Brace frames temporarily to prevent distortion during handling.

3.2 CLEANING AND ADJUSTING

- A. Clean interior lighting luminaires of dirt and construction debris upon completion of installation, or at date of substantial completion, whichever is the nearest to final completion.
- B. Adjust aimable luminaires to provide required light intensities and directional aiming.

3.3 WARRANTY

- A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Lighting Unit and Exit Fixture Batteries: 5 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining 4 years.

- B. Special Warranty for LED Drivers and Light Engines: Manufacturer's standard form in which manufacturer agrees to repair or replace LED light engines and/or drivers that fail in materials or workmanship within specified warranty period.

END OF SECTION 265100

SECTION 283153 – FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The work covered by this section of the specifications includes the furnishing of all labor, equipment, materials, and performance of all operations in connection with the modifications and expansion of the existing fire alarm and detection system.
- B. It is the intent of these specifications to provide additional modules and reprogramming of the existing control panel and to include the additional devices as required for the proposed addition.
- C. All final connections to existing fire alarm system shall be coordinated with an approved Fire Alarm Service Company or the Equipment Manufacturer's Authorized Representative. Contractor shall verify all requirements for alarm system and include all costs of equipment and/or technical support. Contractor shall confirm the scope of work required to upgrade the control panel and power. Contractor shall verify all requirements for alarm system upgrades with the Manufacturer and/or Service Company and include all costs of equipment and / or technical support required.

1.3 SUBMITTALS

- A. Shop drawings shall be submitted prior to rough-in of raceways, wiring and any equipment. Shop drawings shall include:
 - 1. Manufacturer's catalog cuts and Specification for all equipment and devices demonstrating compliance with this specification.
 - 2. Riser diagram showing all existing and new devices, wiring, zoning, etc. for the system.
 - 3. Complete wiring diagram of each panel.
 - 4. Tabulations verifying circuit and battery capacity for all devices.
 - 5. Device wiring diagram for each type of device furnished or connected to.
 - 6. Points of interface connections including, but not limited to, mechanical equipment, access systems, sprinkler systems, etc.
 - 7. Complete narrative on the operation of the system detailing each event in the system and the resulting actions throughout the system and interconnections to other systems.
 - 8. Provide copy of NICET Level IV Certification Certificate for Equipment Supplier.
- B. Shop drawings shall be sent to the respective contractors and/or suppliers, for proper coordination; where their work is interdependent upon signals or controls from the alarm system. These would include those associated with vertical transportation, automatic temperature controls, security, door locks, air handler shutdown, etc.
- C. Shop drawings shall be revised and resubmitted in accordance with the specified shop drawing procedures.

- D. Contractor shall submit signed and sealed drawings, calculations and submittals to the Authority Having Jurisdiction prior to start of any work.

1.4 CODES AND STANDARDS

- A. NFPA 70 - National Electrical Code, as adopted by AHJ
- B. NFPA 72 – National Fire Alarm Code, as adopted by AHJ
- C. American With Disabilities Act (ADAAG)

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70, NFPA 72, and locally enforced codes.
- B. Furnish products listed and classified by UL, FM or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and indicated.
- C. Interconnecting equipment, initiation devices, notification appliance circuit extenders, and annunciating devices shall be UL listed to operate as a unit.

1.6 QUALITY ASSURANCE

- A. Each and all items of the Fire Alarm System shall be listed as a product of a single alarm system manufacturer under the appropriate category by Underwriters' Laboratories, Inc. (UL), and shall bear the "U.L." label. All control equipment is to be listed under UL category UOJZ as a single control unit. Partial listing shall NOT be acceptable.
- B. In addition to the UL requirement mentioned above, the system controls shall be UL listed for Power Limited Applications per NEC 760. All circuits must be marked in accordance with NEC article 760.

1.7 QUALIFICATIONS

- A. Equipment Manufacturer: Honeywell.
- B. Equipment Supplier: Shall be a local Company or local Branch office that is authorized and qualified to provide all the products and equipment to be installed in the fire alarm and detection system. In addition, the Equipment Supplier shall have the following minimum certifications and listings:
 1. A minimum of one individual who works full time with the office of the Equipment Supplier supporting this project who is NICET Certified in Fire Alarm Systems at Level IV. A copy of current Certification Certificate shall be included in the submittal Data required above.
 2. Equipment Supplier shall have been engaged in installations of this type of equipment for at least five (5) years, and has a fully-equipped service organization within fifty (50) miles of the installation.
 3. The Equipment Supplier shall be listed by Underwriters Laboratories, Inc. (U.L.) under category UUJS for Protective Signaling Systems or Factory Mutual Research Approved (FM) for Fire Alarm Service – Local Companies under Standard 3011. A copy of a current Listing or Approved Certificate shall be included in the Submittal Data required above.

1.8 GENERAL

- A. Furnish and install Alarm System equipment as described herein and/or as shown on the plans; to be wired, connected, and left in first class operating condition. The system shall use closed loop initiating device circuits with individual zone supervision, individual notification appliance circuit supervision, incoming and standby power supervision. Include control panel modifications, automatic fire detectors, audio visual, heat detectors, all wiring, connections to devices, outlet boxes, junction boxes, and all other necessary material for a complete operating system.
- B. To accommodate and facilitate job site changes, all hard-wired initiation and control circuits shall be individually configurable, on-site, in any combination, to provide either initiating circuit, notification circuit, or auxiliary control circuit operation.
- C. All panels and peripheral devices shall be the standard product of a single manufacturer and shall display the manufacturer's name on each component.
- D. The system shall be connected to the existing control panel. The system shall provide the necessary components to connect all circuits to the control panel. All new and existing equipment shall be operational upon completion of project.

1.8 SYSTEM OPERATION

- A. All functions of the existing fire alarm system shall remain in operation.
 - 1. Remote communications to off-site monitoring station.
 - 2. Elevator recall.
 - 3. Existing air handler shutdown
- B. Any new or existing automatic or manual initiation of the fire alarm system shall cause alarm notification devices in the original and the addition to operate. The remote communications to off-site monitoring station shall also be initiated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Design and specification is based on retaining and expanding the existing addressable control panel using devices compatible and approved for use with the Honeywell fire alarm panel.
- B. All new products shall be compatible with the existing panel and shall be listed for such use.
- C. All new addressable devices shall match the existing SLC type in use (SK or SD); verify in field

2.2 FIRE ALARM CONTROL PANEL (FACP)

- A. Provide necessary modules to expand existing control panel.
- B. Integral rechargeable batteries and an automatic charger must be an integral function of the control panel and must provide a minimum of 24 hours standby operating time during power outage. Batteries and charger shall be installed or replaced as required to meet requirements.

- C. Provide auxiliary power supply(s) to accommodate additional devices.

2.3 ADDRESSABLE MANUAL PULL STATIONS

- A. Description: Addressable double-action type, red lexan or metal, and finished in red with molded, raised-letter operating instructions of contrasting color. Station will mechanically latch upon operation and remain so until manually reset by opening with a key common with the control units.

2.4 SMOKE DETECTORS

- A. General: Comply with UL 268, "Smoke Detectors for Fire Protective Signaling Systems." Include the following features:
 - 1. Factory Nameplate: Serial number and type identification.
 - 2. Operating Voltage: 24 VDC, nominal.
 - 3. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore normal operation.
 - 4. Plug-In Arrangement: Sensor and associated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection. Base shall provide break-off plastic tab that can be removed to engage the head/base locking mechanism. No special tools shall be required to remove head once it has been locked. Removal of the detector head shall interrupt the supervisory circuit of the fire alarm detection loop and cause a trouble signal at the control unit.
 - 5. Each detector head sensor base shall contain an LED that will flash each time it is scanned by the Control Unit (once every 4 seconds). In alarm condition, the sensor base LED shall be on steady.
 - 6. Each sensor base shall contain a magnetically actuated test switch to provide for easy alarm testing at the sensor location.
 - 7. Each sensor shall be scanned by the Control Unit for its type identification to prevent inadvertent substitution of another sensor type. Upon detection of a "wrong device", the control unit shall operate with the installed device at the default alarm settings for that sensor; 2.5% obscuration for photoelectric sensor, 135-deg F and 15-deg F rate-of-rise for the heat sensor, but shall indicate a "Wrong Device" trouble condition.
 - 8. The sensor's electronics shall be immune from false alarms caused by EMI and RFI.
 - 9. Addressability: Sensors include a communication transmitter and receiver in the mounting base having a unique identification and capability for status reporting to the FACP. Sensor address shall be located in base to eliminate false addressing when replacing sensors.
 - 10. Removal of the sensor head for cleaning shall not require the setting of addresses.
- B. Ceiling Detectors: Smoke sensors shall be of the photoelectric type. Where acceptable per manufacturer specifications, ionization type sensors may be used.
- C. Duct Smoke Detectors: Photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied. Sensor includes relay as required for fan shutdown.
 - 1. The duct housing shall provide a supervised relay driver circuit for driving up to 15 relays with a single "Form C" contact rated at 7A@ 28VDC or 10A@ 120VAC. This auxiliary relay output shall be fully programmable. Mount relay within 3 feet of HVAC control circuit.
 - 2. Duct housing shall provide a relay control trouble indicator Yellow LED.
 - 3. Compact Duct Housing shall have a transparent cover to monitor for the presence of smoke. Cover shall secure to housing by means of four (4) captive fastening screws.
 - 4. Duct Housing shall provide two (2) Test Ports for measuring airflow and for testing. These ports will allow aerosol injection in order to test the activation of the duct smoke sensor.

5. Duct Housing shall provide a magnetic test area and Red sensor status LED.
6. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.
7. Each duct detector shall have a Remote Test Station with an alarm LED and test switch.

2.5 HEAT SENSORS

- A. Thermal Sensor: Combination fixed-temperature and rate-of-rise unit with plug-in base and alarm indication lamp; 135-deg F fixed-temperature setting except as indicated.
- B. Thermal sensor shall be of the epoxy encapsulated electronic design. It shall be thermistor-based, rate-compensated, self-restoring and shall not be affected by thermal lag.
- C. Sensor fixed temperature sensing shall be independent of rate-of-rise sensing and programmable to operate at 135-deg F or 155-deg F. Sensor rate-of-rise temperature detection shall be selectable at the FACP for either 15-deg F or 20-deg F per minute.
- D. Sensor shall have the capability to be programmed as a utility monitoring device to monitor for temperature extremes in the range from 32-deg F to 155-deg F.

2.6 CARBON MONOXIDE DETECTORS

- A. Provide intelligent carbon monoxide detectors and sounder bases at the locations shown on the drawings.
- B. The CO detector shall be listed to UL2075. The alarm level threshold limits shall be per UL 2034. Each CO detector shall provide a signal to the control panel for programming system responses.
 1. Mount each CO detector on a sounder base such that the detector shall initiate a local temporal TC4 tone signal when CO is detected.
 2. The electro-chemical CO sensor shall generate a CO alarm in compliance with UL-2034 requirements. The sensor shall have a nominal ten-year life.
 3. Performing a “sensitivity” check from the panel shall report the approximate number months of sensor life remaining. When the sensor approaches the end of its useful life, it shall transmit a maintenance condition to the control panel, indicating the CO sensor board replacement is required. Only when the sensor is no longer operational shall a trouble condition be sent to the control panel.
 4. Detectors that transmit a common trouble indication for both sensor end-of-life and other causes of detector trouble shall not be considered as equal.
 5. Placing the CO detector in test mode shall facilitate the use of direct injection of small quantities of CO to check detector functionality.

2.6 ADDRESSABLE ALARM-NOTIFICATION APPLIANCES

- A. Addressable Notification Appliances: The Contractor shall furnish and install Addressable Notification Appliances and accessories to operate on compatible signaling line circuits (SLC).
 1. Addressable Notification appliance operation shall provide power, separate control, and supervision of horns and strobes over a single pair of wires. The controlling channel (SLC) digitally communicates with each appliance and receives a response to verify the appliance's presence on the channel. The channel provides a digital command to control appliance operation. SLC channel wiring shall be unshielded twisted pair (UTP), with a capacitance rating of less than

- 60pf/ft and a minimum 3 twists (turns) per foot.
 2. Class B (Style 4) notification appliances shall be wired without requiring traditional in/out wiring methods; addressable "T" Tapping shall be used.
 3. Each Addressable notification appliance shall contain an electronic module and a selectable address setting (in addition to its notification appliance circuit) to allow it to occupy a unique location on the channel. This on-board module shall also allow the channel to perform appliance diagnostics that assist with installation and subsequent test operations. A visible LED on each appliance shall provide verification of communications and shall flash with the appliances address setting when locally requested using a magnetic test tool.
- B. Addressable Controller: Addressable Controller shall supervise Channel (SLC) wiring, communicate with and control addressable notification appliances. Audible (horn) appliances shall have a High/Lo Setting, programmable from the addressable controller per channel host FACP per appliance.
- C. Horn: Addressable horn shall be listed to UL 464. The horn shall have a minimum sound pressure level of 88 dBA @ 16VDC. The horn shall mount directly to a standard single gang, double gang or 4" square electrical box, without the use of special adapter or trim rings. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot.
- D. Visible/Only: Addressable strobe shall be listed to UL 1971. The V/O shall consist of a xenon flash tube and associated lens/reflector system. The V/O enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot. V/O appliances shall be provided with different minimum flash intensities of 15cd, 30cd, 75cd and 110cd. Provide a label inside the strobe lens to indicate the listed candela rating of the specific Visible/Only appliance.
- E. Audible/Visible: Addressable combination Audible/Visible (A/V) Notification Appliances shall be listed to UL 1971 and UL 464. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. Provide a label inside the strobe lens to indicate the listed candela rating of the specific strobe. The horn shall have a minimum sound pressure level of 88 dBA @ 16VDC. The audible/visible enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot. The appliance shall be capable of two-wire synchronization with one of the following options:
1. Synchronized Strobe with Horn on steady
 2. Synchronized Strobe with Temporal Code Pattern on Horn
 3. Synchronized Strobe with March Time cadence on Horn
 4. Synchronized Strobe firing to NAC sync signal with Horn silenced
- F. Isolator Module: Isolator module provides short circuit isolation for addressable notification appliance SLC wiring. Isolator shall be listed to UL 864. The Isolator shall mount directly to a minimum 2 1/8" deep, standard 4" square electrical box, without the use of special adapter or trim rings. Power and communications shall be supplied by the Addressable Controller channel SLC; dual port design shall accept communications and power from either port and shall automatically isolate one port from the other when a short circuit occurs. The following functionality shall be included in the Isolator module:
1. Report faults to the host FACP.
 2. On-board Yellow LED provides module status.
 3. After the wiring fault is repaired, the Isolator modules shall test the lines and automatically restore the connection.

- G. Accessories: Furnish accessories as recommended by the manufacturer.

2.7 ADDRESSABLE CIRCUIT INTERFACE MODULES

- A. Addressable Circuit Interface Modules: Arrange to monitor one or more system components that are not otherwise equipped for addressable communication. Modules shall be used for monitoring of waterflow, valve tamper, non-addressable devices, and for control of evacuation indicating appliances and AHU systems.
- B. Addressable Modules will be capable of mounting in a standard electric outlet box. Modules will include cover plates to allow surface or flush mounting. Modules will receive their operating power from the signaling line or a separate two wire pair running from an appropriate power supply as required.
- C. All Circuit Interface Module shall be supervised and uniquely identified by the control unit. Module identification shall be transmitted to the control unit for processing according to the program instructions. Modules shall have an on-board LED to provide an indication that the module is powered and communicating with the FACP. The LEDs shall provide a troubleshooting aid since the LED blinks on poll whenever the peripheral is powered and communicating.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install/reinstall the system in accordance with the plans and specifications, all applicable codes and the manufacturer's recommendations. All wiring shall be installed in strict compliance with all the provisions of NEC - Article 760, Power-Limited Fire Protective Signaling Circuits or if required, may be reclassified as non-power limited and wired in accordance with NEC-Article 760.
- B. The manufacturer's authorized Equipment Supplier shall provide on-site supervision of installation, and shall make all final connections to existing equipment or wiring.
- C. The Contractor shall fully coordinate with all other trades for the proper wiring and control of all systems.
- D. The Contractor shall maintain the existing system in operation at all times.

3.3 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Equipment Mounting: Install fire-alarm control unit on finished floor with tops of cabinets not more than 72 inches above the finished floor.
- C. Device Mounting: All fire detection and alarm system devices, control panels and remote annunciators shall be installed as follows:
 - 1. Accessible ceilings (lay-in ceilings or suspended drywall or similar construction)
 - a. flush mounted devices with recessed box and concealed wiring/conduit

2. Inaccessible ceilings (exposed 'open' structure or inaccessible ceilings)
 - a. unfinished spaces; surface mounted devices using exposed conduit and boxes
 - b. finished spaces; surface mounted devices using surface raceway
3. Hollow walls (stud walls or hollow CMU)
 - a. flush mounted devices with recessed box and concealed wiring in conduit
 - b. surface devices with exposed conduit may be used only in unfinished spaces (mechanical / electrical rooms or similar areas) or as approved by the Architect/Engineer.
4. Solid walls (solid masonry)
 - a. surface mounted devices with surface raceway system
 - 1) exposed conduit may be used only in unfinished spaces (mechanical / electrical rooms or similar areas as defined by the Architect)).

D. Smoke- or Heat-Detector Spacing:

1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet.
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A in NFPA 72.
5. HVAC: Locate detectors not closer than 3 feet where in the direction of airflow, or 5 feet otherwise, from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.

E. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Install remote test station in public area below concealed detectors or in accessible area within mechanical areas.

F. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Locate detectors within two feet of associated sprinkler.

G. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

H. Annunciator: Install with top of panel not more than 72 inches above the finished floor.

3.4 WIRING

A. Route cable for all device wiring within accessible ceiling cavities. Install in bridle rings at maximum 4' spacing. No cabling is to lie on or attach to ceiling tile, ducts, pipes, conduits or ceiling suspension wires, rods or structural members. Provide conduit stubs from devices and panels to the ceiling cavities. Provide bushings at conduit ends. All wiring in area of exposed structure shall be installed in conduit.

B. All conductors shall be type THHN or THWN insulated in conduit, or plenum rated fire alarm cable acceptable to Authority Having Jurisdiction. The minimum conductor size shall be #14 AWG for

detectors and #12 AWG for power supply and controls. All conductors shall be installed without the use of splices or lubrication except for powdered soapstone. All wires shall be color coded.

- C. All Wiring shall be identified at the control panel and at each terminal and junction box.
- D. Control panel, annunciators, standby power module must be mounted with sufficient clearance for observation and testing. Final arrangement and location must be approved by the Owner/Engineer.
- E. Flexible connections are to be used for all devices mounted in suspended lay-in ceiling panels. All conduit, mounting boxes, junction boxes and panels are to be securely hung and fastened with appropriate fittings to insure positive grounding throughout the entire system. No wiring other than that directly associated with alarm detection, alarm or auxiliary functions will be permitted in alarm raceways.
- F. Conductors in cabinets must be carefully formed and harnessed so that each drops off directly opposite to its terminal. Each Conductor and Cabinet terminal must be numbered and coded.
- G. Wiring splices are to be avoided to the extent possible and, if needed, they must be made only in junction boxes which are to be painted fire alarm red.
- H. Color codes must be used throughout. Transposing or changing color coding of wires will not be permitted. Wire nut type connections are not acceptable. All conductors in conduit pull boxes or cabinets containing more than one wire must be labeled on each end with “E-Z Markers” or equivalent.
- I. The Contractor shall use the types and size wire recommended by the equipment manufacturer. However, the size and quality shall not be less than specified or shown on the drawing/riser diagram. The contractor in no case shall use the type of wire which he assumes to be the best. The recommendation shall be from the equipment supplier.
- J. End-of-Line Devices: Mount end-of-line device in box with last device or separate box adjacent To last device in circuit. Indicate the exact location of the end-of-line device on the as-built drawings.
- K. Connections to Auxiliary Devices: Make conduit and wiring connections to door release devices, fire suppression system control panels, motorized smoke dampers, etc.
- L. Trim Rings: Provide trim rings where flush mounted initiating and signaling devices do not completely cover the opening in the wall or ceiling surface.

3.5 AUTHORIZED EQUIPMENT SUPPLIER’S FIELD SERVICES

- A. Include services of certified technician to supervise installation, adjustments, final connections, and system testing as required by local codes.
- B. Program the actual owner-assigned room names/numbers for alarm location indication on displays. System is not considered acceptable with architectural or manufacturer assigned numbers for spaces and devices.

3.6 CLEANING AND ADJUSTING

- A. Cleaning: Remove paint splatters and other spots, dirt and debris. Touch up scratches and mars of finish to match original finish. Clean unit internally using methods and materials recommended by manufacturer.

3.7 FIELD QUALITY CONTROL

- A. Acceptance Testing: A 100% Acceptance Test shall be conducted by the Approved Equipment Supplier to meet the requirements of NFPA 72 (1996) Chapter 7. The Record of Completion shall indicate the total number of items tested in the system.
- B. Project Closeout Requirements:
 - 1. Record of Completion: The Equipment Supplier shall complete the Record of Completion as required in NFPA 72 (1996). Any deficiencies that are to be listed on the Record of Completion shall be reviewed with the Architect/Engineer on record for the project before the Authority Having Jurisdiction is requested to sign the document. Upon approval, the original copy of the completed Record of Completion, signed by all required parties, shall be submitted through the Contractor to the Architect/Engineer and Building Owner.
 - 2. Point to point wiring diagrams of each device as well as drawings of the completed system and reflecting any changes that were made from the original submission of drawings;
 - 3. Copy of the system program in printed form and on a compact disc;
 - 4. Three sets of Operating and Instruction Manuals of the entire system;
 - 5. Copy of the Certificate for Listing or Placarding the system

3.8 INSTRUCTION

- A. Furnish the services of a field representative who shall be a fulltime employee of the systems supplier. The field service representative shall have specialized experience in the operation and maintenance of the systems and shall instruct the owner's personnel in the techniques involved in the operation of the systems.
- B. Formal on-site training shall be provided to the owner's representative/maintenance personnel and shall include instructions in the location, inspection, maintenance, testing, and operation of all electronic components.
- C. Provide a signed copy of the name(s) of the personnel giving the instructions and the personnel of the owner who were instructed.

3.9 WARRANTY

- A. The contractor shall warrant the new alarm system wiring and equipment to be free from inherent mechanical and electrical defects for a period of one (1) year from the date of the completed and certified test or from the date of first beneficial use. Any repairs during this time are to be provided by the Contractor during normal working hours at no cost to the Owner.

END OF SECTION 283153

TECHNICAL SPECIFICATIONS

For

**CB LAMB ELEMENTARY SCHOOL RENOVATIONS
PHASE I**

OUR FILE No.: SCE-R10554.011

BOROUGH OF WRIGHTSTOWN, COUNTY OF BURLINGTON, STATE OF NEW JERSEY



APRIL 2019

04-15-2019

DAREN J. PHIL, PE

Date

NJPE LICENSE #24GE03619100

SUBURBAN CONSULTING ENGINEERS, INC.

96 U.S. Highway 206, Suite 101, Flanders, New Jersey 07836
973-398-1776; Fax 973-398-2121

SECTION 311000 SITE CLEARING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Instructions to Bidders, General Conditions, and Supplementary Instructions to Bidders and General Conditions, and other Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Refer to “Division 1 General Requirements” for temporary utilities, temporary construction and support facilities, temporary security and protection facilities, and temporary erosion and sedimentation control procedures.
 - 2. Refer to “Division 1 General Requirements” for verifying utility locations and for recording field measurements.
 - 3. Division 31 Section 311001 "Tree Protection and Trimming" for protecting trees remaining on-site that are affected by site operations.
 - 4. Division 32 Section 329200 "Turf and Grasses" for finish grading including preparing and placing planting soil mixes and testing of topsoil material.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Protecting existing trees, shrubs, groundcovers, plants and grass to remain.
 - 2. Removing existing trees, shrubs, groundcovers, plants and grass, as applicable.
 - 3. Clearing and grubbing.
 - 4. Stripping and stockpiling topsoil.
 - 5. Removing above- and below-grade site improvements including the classroom trailer, covered walkway and appurtenances, selective/partial demolition and removal of existing improvements.
 - 6. Disconnecting, capping or sealing, abandoning, and removal of above- and below-grade site utilities.
 - 7. Cleaning and protection of existing drainage structures and pipes.
 - 8. Temporary erosion and sedimentation control measures.
- B. All site clearing activities and sediment control measures are to be performed as part of the Base Bid.

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 one inch (1”) in diameter; and free of subsoil and weeds, roots, toxic materials, or other non-soil 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.
- B. The Owner shall retain right of first refusal on all utility structures indicated to be removed as a part of the work in this section

1.5 SUBMITTALS

- A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.
- B. Record drawings, according to other Sections of the Specification identifying and accurately locating capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

- A. Pre-installation Conference: Conduct conference at Project site to comply with requirements in "Division 1 General Requirements".

1.7 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, parking areas, pedestrian zones, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
 - 3. There are no proposed improvements on adjoining property for this project.
- B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises or designated area where indicated.
- C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing. New Jersey One-Call must be contacted at 1-800-272-1000 at least three (3) full working days, but not more than ten (10) days, prior to the planned start date of the excavation or site clearing operations.
- D. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

- A. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

PART 3 EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly flag trees and vegetation to remain or to be relocated.
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 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 and walkways, as required by the Soil Erosion and Sediment Control Standards of New Jersey and as directed by the Engineer. Install any additional erosion and sediment control measures as necessary to meet the directives of the Engineer during the Work. Although a site specific soil erosion permit has not been obtained, the Contractor is responsible for furnishing, installing and maintaining any and all soil erosion measures such as inlet filters, silt fence, etc. as shown in plans, or deemed reasonable by the Engineer.
- 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.

3.3 UTILITIES

- A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed and/or abandoned.
 - 1. Contractor shall arrange with utility companies to shut off site utilities to be removed.
- B. 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. Do not proceed with utility interruptions without A/E's written permission.
 - 2. Protect underground utilities if exposed by Work.

C. Proposed Utilities

1. The Contractor is also responsible under the Site Clearing item for the protection of the public, equipment and proposed installed structures for the duration of the construction period. This shall include installation of temporary fencing around disturbed areas, pedestrian walkway bypasses and construction signage.

3.4 CLEANING OF EXISTING DRAINAGE STRUCTURES AND PIPES

A. Site Clearing shall also include the silt and sediment removal from all inlets, as well as the removal of grass, scale, and other debris from the associate grates within the limits of the project site and all piping and structures interconnected to the piping within the limits of the school property. This includes disposal of all removed materials and photographic documentation of conditions to the engineer.

1. At least five (5) days before beginning the work, submit a plan to the Engineer detailing the proposed method and equipment to be used. Remove and collect silt, debris, and material. Ensure that the material is not discharged into the drainage system. Dispose of materials removed from the existing structure in accordance with paragraph 3.8 below.
2. The work shall include all labor, tools, equipment and related items as may be required for the complete cleaning and jetting of the site's storm drainage system and removing and disposing of all deposits cleaned from the drains.

B. Cleaning Procedures and Equipment.

1. The Contractor shall clean storm drain structures and piping prior to internal inspection, utilizing cleaning equipment approved for use by the Engineer. The Contractor shall ensure that the scope of work assumed during bidding shall be sufficient for removing all shapes, sizes and quantities of debris.
2. Cleaning equipment may consist of hydraulic high-pressure jet machines, heavy duty power rodding machines capable of cleaning distances applicable to the site in one step and heavy-duty bucket machines that can be used to drag line work with buckets, brushes, scrapers, swabs or other similar devices. The heavy-duty equipment may be necessary for the removal of roots or heavy debris.
3. Power rodding equipment shall have the capability of spinning the rod either clockwise or counter-clockwise. The equipment shall also be capable of pushing or pulling the rod without rotating the machine.
4. All cleaning equipment, including machines, devices, tools, etc., required for the entire cleaning operations shall be owned or leased and operated by the Contractor. The Contractor shall also submit his equipment list to the Engineer before commencement of the work.
5. The equipment utilized shall be capable of removing all sand, dirt, rocks and other debris, including roots (where ordered by the Engineer), from the drain line to allow adequate internal inspection (in the opinion of the Engineer) of all internal surfaces. The equipment used shall suit the conditions and size of the drain system to be cleaned.
6. All safety precautions outlined in the General Requirements, or required by agencies having jurisdiction, shall be followed by the Contractor during cleaning operations. The cost of such precautions shall be included in the price bid for this item.
7. All precautions shall be taken by the Contractor to protect the storm drain from damage that might result from the use of unsuitable equipment or improper use of approved cleaning equipment. Any drains damaged during the cleaning operations as a result of the Contractor's operations shall be promptly repaired to an acceptable condition (as determined by the Engineer) by and at the expense of the Contractor. If the Contractor's cleaning equipment becomes immobilized within a storm drain, exits the line through broken pipe or portions break off within a storm drain, said

equipment shall be retrieved at the Contractor's expense. The Contractor shall act immediately to remedy problems created by the cleaning procedure, which represent a hazard to the general public, such as the collapse of the ground surface above a storm drain. If equipment retrieval necessitates excavation, the Contractor shall be responsible for accomplishing the work at his own expense. Following removal of the equipment, the Contractor shall restore the line and the site in accordance with the construction specifications of the governing body having jurisdiction.

3.5 CLEARING AND GRUBBING

- A. Prior to clearing and grubbing, request in writing for the removal of obstructions, trees, tree branches, 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 only where such roots and branches obstruct installation of new construction.
 - 3. Grind stumps and remove roots, obstructions, and debris extending to a depth of eighteen inches (18") below exposed subgrade.
 - 4. Use only hand methods for grubbing within tree protection zone.
 - 5. Chip removed tree branches and dispose of off-site.
- B. 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 eight inches (8"), and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 1. Remove subsoil and non-soil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.
- C. 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. Stockpile surplus topsoil to allow for re-spreading as project conditions require.

3.7 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

3.8 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.
 - 1. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

3.9 LIMITS OF SITE CLEARING

- A. The Contractor shall be fully aware of the limits of Site Clearing based on project plans. In general, the limit of Site Clearing includes all tasks as described above that are required to complete the applicable tasks associated with all works items in the contract.

END OF SECTION

SECTION 311001 TREE PROTECTION AND TRIMMING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Instructions to Bidders, General Conditions, and Supplementary Instructions to Bidders and General Conditions, and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the protection and trimming of existing trees that interfere with, or are affected by, execution of the Work, whether temporary or permanent construction.
- B. Related Sections include the following:
 - 1. Division 31 Section 311000 "Site Clearing" for removal limits of trees, shrubs, and other plantings affected by new construction.
- C. All payment for tree protection and trimming required to allow the Contractor to perform their Work shall be included in the Base Bid. Tree protection and trimming shall not be measured for payment.

1.3 DEFINITIONS

- A. Tree Protection Zone: Area surrounding individual trees or groups of trees to remain during construction and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Drainage Fill: Selected crushed stone, or crushed or uncrushed gravel, washed, ASTM D 448, Size 24, with 90 to 100 percent passing a 2-1/2-inch sieve and not more than ten percent (10%) passing a 3/4-inch sieve.
- B. 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 one inch (1") in diameter; and free of weeds, roots, and toxic and other non-soil materials.
- C. Sand: coarse grained soil material passing the No. 4 but not passing the No. 200 sieve.
- D. Steel Plate: 3/4 inch thick steel plating to temporarily protect tree roots in accordance with the construction details during construction activities by heavy vehicles.

- E. Filter Fabric: Manufacturer's standard, nonwoven, pervious, geotextile fabric of polypropylene, nylon, or polyester fibers.
- F. Tree Protection Fencing: Blaze orange mesh.

PART 3 EXECUTION

3.1 PREPARATION

- A. Temporary Fencing: Install silt fence or tree protection fencing as indicated on the Construction Plans at the limit of disturbance to protect indicated trees and vegetation from construction damage. Maintain temporary fence and remove when construction is complete according to permit requirements.
 - 1. Install fencing according to permit requirements.
- B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.
- C. Do not store construction materials, debris, or excavated material inside tree protection zones. Do not permit vehicles or foot traffic within tree protection zones; prevent soil compaction over root systems.
- D. Maintain tree protection zones free of weeds and trash.
- E. Do not allow fires within tree protection zones.
- F. Where travel through tree protection zones is necessary due to site constraints, protect tree roots using tree root protection detail on the Plans.

3.2 EXCAVATION

- A. Where excavation for new construction is required within tree protection zones, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks and comb soil to expose roots.
 - 1. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately three inches (3") back from new construction.
 - 2. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.
- B. Where trenches are required within tree protection zones, tunnel under or around roots by drilling, auger boring, pipe jacking, or digging by hand, if possible.
 - 1. Root Pruning: Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of the Work. Cut roots with sharp pruning instruments; do not break or chop.

3.3 REGRADING

- A. Minor Fill: Where existing grade is six inches (6”) or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.

3.4 TREE PRUNING

- A. Prune trees to remain that are affected by temporary and permanent construction.
 - 1. Where existing retaining walls are to be rehabilitated, all trees shall be pruned to provide two feet (2’) of clearance from existing/proposed retaining wall.
 - 2. In areas of work adjacent to existing visitor’s bleacher, all trees shall be pruned to the limit of the existing chain link fence fabric face.
- B. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by arborist.
- C. Pruning Standards: Prune trees according to ANSI A300 (Part 1).
- D. Cut branches with sharp pruning instruments; do not break or chop.
- E. Chip removed tree branches and dispose of off-site.

3.5 TREE REPAIR AND REPLACEMENT

- A. Promptly repair trees damaged by construction operations within 24 hours. Treat damaged trunks, limbs, and roots according to arborist's written instructions.
- B. Remove and replace trees indicated to remain that die or are damaged during construction operations that Engineer determines are incapable of restoring to normal growth pattern.
 - 1. Provide new trees of same size and species as those being replaced; plant and maintain.
- C. Aerate surface soil, compacted during construction, ten feet (10’) beyond drip line and no closer than 36 inches to tree trunk. Drill two-inch (2”) diameter holes a minimum of twelve inches (12”) deep at 24 inches on-center. Backfill holes with an equal mix of augered soil and sand.

3.6 DISPOSAL OF WASTE MATERIALS

- A. Burning is not permitted.
- B. Disposal: Remove excess excavated material and displaced trees from Owner's property.

END OF SECTION

**SECTION 315000
EXCAVATION SUPPORT AND PROTECTION**

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Instructions to Bidders, General Conditions, and Supplementary Instructions to Bidders and General Conditions, and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes temporary excavation support and protection. Any support and protections systems required for the Work are to be included as part of the Base Bid lump sum price.

1.3 PERFORMANCE REQUIREMENTS

- A. Design, furnish, install, monitor, and maintain excavation support and protection system and permanent sheet piling capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction and permanent loads as necessary to complete the work.
 - 1. Delegated Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 - 2. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 3. Install excavation support and protection systems and permanent steel sheet piling without damaging existing buildings, structures, and site improvements adjacent to excavation.
 - 4. Monitor vibrations, settlements, and movements.

1.4 SUBMITTALS

- A. Shop Drawings: For excavation support and protection system and permanent steel sheet piling.
- B. Other Informational Submittals:
 - 1. Photographs: Show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by the absence of, the installation of, or the performance of excavation support and protection systems and permanent steel sheet piling. Submit before Work begins.
 - 2. Record Drawings: Identifying and locating capped utilities and other subsurface structural, electrical, or mechanical conditions.

1.5 QUALITY ASSURANCE

- A. Pre-installation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to excavation support and protection system and permanent steel sheet piling including, but not limited to, the following:
 - a. Geotechnical report.

- b. Existing utilities and subsurface conditions.
- c. Proposed excavations.
- d. Proposed equipment.
- e. Monitoring of excavation support and protection system.
- f. Working area location and stability.
- g. Abandonment or removal of excavation support and protection system.
- h. Detail of capping for permanent steel sheet piling.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
 - 1. Notify A/E no fewer than two days in advance of proposed interruption of utility.
 - 2. Do not proceed with interruption of utility without A/E's written permission.
- B. Survey Work: Engage a qualified land surveyor to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.
 - 1. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify A/E if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 PRODUCTS

2.1 MATERIALS AND REFERENCES

- A. General: Provide materials that are either new or in serviceable condition.
- B. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.

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 that could develop during excavation support and protection system and permanent steel sheet pile operations.
 - 1. Shore, support, and protect utilities encountered.
- B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities. Install and permanent steel sheet piles as depicted in the project plans and as necessary to complete the work.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from State and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

- C. Locate excavation support and protection systems clear of permanent construction so that forming and finishing of concrete surfaces are not impeded.
- D. Monitor excavation support and protection systems and permanent steel sheet piles daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems and permanent steel sheet piles remain stable.
- E. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems and permanent steel sheet piles.

3.2 BRACING

- A. Bracing: Locate bracing to clear base course materials, pre-cast concrete structures and other permanent work. If necessary to move bracing, install new bracing before removing original brace.
 - 1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by A/E.
 - 2. Install internal bracing, if required, to prevent spreading or distortion of braced frames.
 - 3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.3 REMOVAL AND REPAIRS

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.
 - 1. Remove excavation support and protection systems to a minimum depth of 48 inches below overlaying construction and abandon remainder.
 - 2. Fill voids immediately with approved backfill.
 - 3. Repair or replace, as approved by A/E, adjacent work damaged or displaced by removing excavation support and protection systems.

3.4 SAFETY PROCEDURES

- A. Follow safety procedures according to the latest OSHA regulations.

3.5 INSPECTION

- A. The General Contractor shall inspect the excavation support and protection systems and permanent steel sheet piles on a daily basis for damage or evidence of potential failure. Daily logs are to be maintained by the General Contractor and be made available to the A/E or State representatives upon request.

END OF SECTION

SECTION 321216 ASPHALT PAVING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cold milling of existing hot-mix asphalt pavement.
 - 2. Hot-mix asphalt paving.
 - 3. Pavement-marking paint.
- B. Various asphalt mix designs are to be used in the scope of this project including but not limited to NJDOT base course 19 M64 and surface courses 9.5 M64. The Contractor is directed to the plans for additional information.
- C. In addition to this specification, paving shall meet or exceed the requirements of the NJDOT 2007 Specifications for Asphalt and Asphalt Paving. In addition, many tolerance requirements are necessary for the project.
- D. Materials as specified on the plans are designed to specific depth based on use. The depth tolerances shall be in accordance with the NJDOT Standard Specifications. If the Engineer chooses to request depth confirmation testing, the contractor shall be responsible to provide the coring, patching and repairing necessary at no additional cost. The asphalt cores will be tested in conformance with the NJDOT method and the Contractor shall be subject to the penalties/obligations/requirements imposed for insufficient pavement depth. No additional payment will be made for asphalt that is thicker than the required depth specified.

1.3 DEFINITION

- A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
 - 1. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

- B. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces as applicable. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities as applicable.
- C. Samples: For each paving fabric, twelve inches by twelve inches (12" x 12") (304.8 by 304.8 mm) minimum.
- D. Qualification Data: For qualified Manufacturer and Installer.
- E. Material Certificates: For each paving material, from manufacturer.
- F. Material Test Reports: For each paving material.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by NJDOT.
- B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.
- C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of NJDOT Standard Specifications for Road and Bridge Construction, 2007, and all addenda thereto for asphalt paving work.
 - 1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.
- D. Preinstallation Conference: Conduct conference at Project Site.
 - 1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
 - a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
 - b. Review condition of subgrade and preparatory work.
 - c. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
 - d. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.
- B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
1. Prime Coat: Minimum surface temperature of 60°F.
 2. Tack Coat: Minimum surface temperature of 60°F.
 3. Slurry Coat: Comply with weather limitations in ASTM D 3910.
 4. Asphalt Base Course: Minimum surface temperature of 40°F and rising at time of placement.
 5. Asphalt Surface Course: Minimum surface temperature of 60°F at time of placement.
- B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature 55°F for water-based materials, and not exceeding 95°F.

PART 2 PRODUCTS

2.1 MIXES

- A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction; designed according to procedures in the NJDOT Standard Specifications, 2007 and complying with the following requirements:
1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
 2. Base Course: NJDOT 19 M64
 3. Surface Course: NJDOT 9.5 M64

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to begin paving.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
1. Proof roll with a loaded ten (10) wheel, tandem-axle dump truck weighing not less than fifteen (15) tons (13.6 tonnes).
 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 COLD MILLING

- A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
1. Mill to a to full depth

2. Control milling speed and depth to product uniform milling material for reuse if selected by the Contractor.
3. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
4. Stockpile milled hot-mix asphalt for mixing and reuse. Excess millings shall be delivered to asphalt recycling facility.
5. Keep milled pavement surface free of loose material and dust.

3.3 PATCHING

- A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending twelve inches (12") (304.8 mm) into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
- B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseal concrete pieces firmly.
 1. Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseal pieces firmly.
 2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.
- C. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).
 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- D. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.
- E. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.4 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd. (0.7 to 2.3 L/sq. m). Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure.
 1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
 2. Protect primed substrate from damage until ready to receive paving.

- C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.5 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
 - 1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
 - 2. Place hot-mix asphalt surface course in single lift.
 - 3. Spread mix at minimum temperature of 250°F (121°C).
 - 4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
 - 5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than ten feet (10') (3 m) wide unless infill edge strips of a lesser width are required.
 - 1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.6 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
 - 1. Complete compaction before mix temperature cools to 185°F (85°C).
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
 - 1. Average Density: 96% of reference laboratory density according to ASTM D 6927, but not less than 94 percent nor greater than 100%.
 - 2. Average Density: 92% of reference maximum theoretical density according to ASTM D 2041, but not less than 90% nor greater than 96%.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.7 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 - 1. Base Course: Plus or minus 1/2 inch (12.7 mm).
 - 2. Surface Course: Plus 1/4 inch (6.4 mm), no minus.
- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a ten-foot (10') (3 m) straightedge applied transversely or longitudinally to paved areas:
 - 1. Base Course: 1/4 inch (6.4 mm)
 - 2. Surface Course: 1/8 inch (3.2 mm)
 - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6.4 mm).

3.8 SURFACE

- A. Allow paving to age for 60 days before starting pavement marking if applicable.

3.9 PAVEMENT MARKING

- A. See plans for location and configuration of pavement markings.
- B. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Engineer.
- C. Allow paving to age for 60 days before starting pavement marking.
- D. Sweep and clean surface to eliminate loose material and dust.
- E. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of fifteen (15) mils (0.4 mm).
 - 1. Broadcast glass beads uniformly into wet pavement markings at a rate of six (6) lb./gal. (0.72 kg/L).

3.10 DISPOSAL

- A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.
 - 1. Do not allow milled materials to accumulate on-site.

END OF SECTION

SECTION 329113
TOPSOIL PLACEMENT, PREPARATION AND GRADING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to work of this Section.
- B. Related Work Specified Elsewhere:
 - 1. Division 32 Section 329200 “Turf and Grasses”

1.2 GENERAL

- A. The work included in this section of the specifications shall consist of all labor, material and equipment required for the Contractor to undertake stripping, stockpiling and replacement of topsoil throughout the site. It shall further include the furnishing and placement of additional topsoil as required to provide a covering throughout the area to be seeded. In general, all areas of the site which are disturbed by construction and are not otherwise improved shall be topsoiled and seeded.
- B. All work included in this section shall meet the requirements of the local Soil Conservation District and be in accordance with the "Standards for Soil Erosion and Sediment Control in New Jersey, July 2017".

PART 2 PRODUCTS

The Contractor shall furnish all materials and labor to completely restore the surface vegetation of all existing vegetated areas that are disturbed within the limits of construction with topsoil, seed, fertilizer, mulch and other incidentals to the site as directed by the Engineer and as specified under this Item.

2.1 TOPSOIL

- A. Topsoil shall be friable and loamy, free of debris and objectionable weeds and stones and contain no toxic substance that may be harmful to plant growth. Topsoil hauled in from off-site shall have a minimum organic matter content of 2.75%. Organic matter content shall be raised by additives at the Contractor’s own expense. A pH range of 5.0-7.5 is acceptable and soluble salts should not be excessive.
- B. Topsoil taken from original excavations shall be carefully stored separately and after completion of the rough grading, shall be spread, graded and rolled to the grades prior to excavation and shall conform to the pre-existing elevations. A minimum thickness of topsoil of four inches (4”) will be required.

- C. All topsoil shall be natural topsoil sandy loam, thoroughly cleared of all sticks, roots, branches, coarse sods and other deleterious matter, and all stones larger than one inch in diameter before it is spread. Topsoil shall contain at least three percent (3%) organic matter determined by loss on ignition of moisture-free samples. The acidity range shall be pH 5.0 to pH 7.0, inclusive. The mechanical analysis of the soil shall be:

<u>Passing</u>	<u>Retain On</u>	<u>Percentage</u>
1" Screen		100%
1" Screen	¼" Screen	3%
¼" Screen	#100 Sieve	40% - 60%
#100 Sieve	(Fines)	40% - 60%

- D. Six (6) random samples are to be taken by the Contractor, tested and results provided to the Project Engineer prior to seeding or sodding.
- E. **The following gradation, physical analysis and test results must be provided prior to topsoil purchase and placement:**
1. Soil Test and Interpretation
 - a. Soil Texture
 - b. PH
 2. Macronutrients (pounds / acre)
 - a. Phosphorus
 - b. Potassium
 - c. Magnesium
 - d. Calcium
 3. Micronutrients
 - a. Zinc
 - b. Copper
 - c. Manganese
 - d. Boron
 4. Special Tests and Results
 - a. Electrical Conductivity: Soluble Salt Level
 - b. Gravel Content (%)
 - c. Soil Organic Matter
- F. The Topsoil shall meet adequate levels for the above requirements and provide recommendations for correction if necessary. The following are recommendations:
- G. Physical Analysis (Soil Texture)
1. Amounts of sand, silt and clay – determined by official hydrometer method or mechanical analysis of the soil. Gravel sized particles should be determined by mechanical analysis separation on screens with appropriately sized openings.
 2. Soils should be relatively free of undecomposed organic material such as roots, sticks, leaves and paper and of any undesirable material such as grass, plastic or metal fragments that would have to be removed prior to seeding or sodding.

H. Chemical Analysis

1. Modify existing soil by adding high quality compost to achieve the organic matter content.
 2. Organic matter content (% oven dry weight of soil)
 - a. Sandy loam 1.25% to 10%
 - b. Loam and silt loam 2.5% to 10%
 - c. On soil with less than ten percent (10%) organic matter, use wet oxidation method of analysis or on soil with more than ten percent (10%) organic matter use loss on ignition method of analysis.
 3. Soluble salt content – Conductivity (Ece, millimhos per centimeter)
 - a. Less than 1.0 mmhos/cm for a 1:1 soil: water ratio
 - b. Less than .5 mmhos/cm for a 1:2 soil: water ratio
 - c. Less than .33 mmhos/cm for a 1:3 soil: water ratio
- I. The Contractor shall provide a sample of any topsoil (at least 1/2 gal) together with a laboratory analysis for physical and chemical characteristics for approval by the Engineer or designated representative before blending at the site. After soil blending occurs and prior to placement of soil on site, the Contractor shall submit a laboratory analysis for physical and chemical characteristics for approval by the Engineer.
- J. Soil blending process shall be monitored by the Engineer or designated representative for conformance to specifications. Topsoil shall also be free of Quackgrass rhizomes, Agropyron Repens, and the nut-like tubers of Nutgrass, Cyperus Esculentus, and all other primary noxious weeds.
- K. Any Topsoil which does not meet specifications shall be removed by the Contractor and replaced with specified soil at his/her expense.

2.2 FERTILIZER

- A. Fertilizer shall be an approved commercial brand having an analysis of 10-20-10 (ten (10) pounds of nitrogen, twenty (20) pounds of available phosphoric acid, and ten (10) pounds of water soluble potash) respectively, for each 100 pounds of mixture.
- B. The fertilizer must be a uniform granular consistency of -8 to +16 mesh (with minimum of 85% retention), using the Tyler Standards, having a maximum allowable dust of five percent (5%) and packed in three (3)-ply laminated paper bags (or comparable).
- C. Fertilizer shall be delivered in unopened sacks, bearing the trade name, manufacturer's name, weight and analysis. Each delivery of fertilizer shall be accompanied by a delivery slip indicating the number of bags and the weight. The delivery slip shall be furnished to the Consultant or his agent at the time of delivery.
- D. Fertilizer shall not have been exposed to weather prior to delivery on the site, and after delivery, until used, it shall be completely protected at all times. It shall not be stored in direct contact with the ground. Any fertilizer that becomes caked or otherwise damaged, making it unsuitable for use, will not be accepted.
- E. The fertilizer shall be applied at a rate of fifteen (15) pounds per 1000 square feet, or approximately 650 pounds per acre. The method of application for fertilizer shall be any method that uniformly and thoroughly incorporates the specified application into the two inches (2") of the topsoil layer.
- F. The application of fertilizer shall not precede the performance of seeding by more than ten (10) days.

PART 3 EXECUTION

3.1 TOPSOILING

- A. Topsoil taken from original excavations shall be carefully stored separately and, after completion of the rough grading, shall be spread, graded and rolled to the grades prior to excavation or shall conform to the elevations shown on the drawings. Establish finish grades to within 0.05 foot of grades indicated to prevent ponding. A minimum thickness of topsoil of four inches (4") will be required.
- B. Topsoil shall not be placed until the area to be topsoiled has been approved. All stones ½ inch or larger in any dimension, and other debris such as wires, cables, tree roots, pieces of concrete, clods and lumps shall be removed. If the surface to receive Topsoil has become compacted during construction operations, then the contractor must scarify the surface to provide an improved bond between the surface and topsoil. The topsoil shall be spread on a previously prepared surface in a uniform layer to produce the prescribed thickness.
- C. The Contractor shall allow in his/her bid for the application of pulverized limestone at a rate of 100 lbs. per 1,000 square feet to all topsoil, both imported and onsite materials.
- D. Where either embankment or excavation slopes become eroded during the work and before acceptance, repairs shall be made at no additional cost to the Owner.
- E. No greater than one inch (1") of depth shall be lost to natural settlement, picking of rocks and final preparation of seed beds. If any area is found to have lost greater than one inch (1"), additional topsoil shall be spread to raise depths to the original minimum depth.
- F. Fine grade and rake topsoiled areas to a smooth, uniform surface. Compact with an approved roller weighing approximately 500 pounds. Regrade and reroll until satisfactory grades as shown are obtained with the required depths of topsoil. Do not finish grade during unsuitable weather.
- G. Topsoil spreading shall be performed in such a manner that seeding can proceed with a minimum of additional soil preparation and tillage. Irregularities in the surface resulting from topsoiling or other operations shall be corrected in order to prevent the formation of depressions or crowns. Topsoil shall not be placed while the ground is frozen or muddy, or in a condition that may otherwise be detrimental to proper grading. After the topsoil has been spread and the final grade is established, the area shall be cleared of all grade stakes, surface trash and debris.
- H. The Contractor shall, wherever possible, conduct topsoiling immediately upon completion of approved subgrade preparation. The Contractor shall commence seeding, or other finished surfacing operations immediately upon completion of approved topsoil installation.
- I. In no case shall completed topsoiled lawn areas which have been topsoiled stand for more than two days prior to commencement of seeding.
- J. Any damage to seeded areas caused by pedestrian or vehicular traffic or other causes shall be repaired at no cost to the Owner.

3.2 FERTILIZING

- A. After topsoil is in place, the Contractor shall apply limestone and fertilizer in accordance with local Soil Conservation standards.
- B. Lime shall be ground dolomitic limestone not less than 85% total carbonates, ground so that 50% passes through a 100-mesh sieve and 90% through a 20-mesh sieve.
- C. Ground limestone shall be evenly applied at a rate of 135 lbs./1,000 square feet to all areas to be seeded and shall be thoroughly and evenly mixed with the soil to a depth of four inches (4") below finished grade. All areas to be seeded or sodded shall then be fine graded to remove all ridges and depressions and the surface shall be cleaned of all stones greater than two inches (2") in diameter, and other debris.
- D. After preparation of the seed bed and at least nine (9) days before seeding, an approved commercial 10-20-10 fertilizer shall be incorporated into the soil at a rate of 14 lbs./1000 square feet, and to a depth of four inches (4"). The soil shall then be thoroughly watered.

END OF SECTION

**SECTION 329200
TURF AND GRASSES**

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Review these documents for coordination with additional requirements and information that apply to work under this Section.

1.2 SUMMARY

- A. This work shall consist of all labor, materials, and equipment necessary for the furnishing and placement of topsoil outside of the sport field area. This includes but is not limited to the preparation of areas to receive topsoil, screening of topsoil (if needed), and the delivery and placement of topsoil. Topsoil available from the sites as a result of clearing site operations shall be evaluated for use on the site.

PART 2 PRODUCTS

2.1 TOPSOIL

- A. Topsoil requirements are found in Division 32 Section 329113 “Topsoil Placement, Preparation and Grading.”

2.2 FERTILIZER

- A. Fertilizer shall be an approved commercial brand having an analysis of 10-20-10 (ten (10) pounds of nitrogen, twenty (20) pounds of available phosphoric acid, and ten (10) pounds of water soluble potash) respectively, for each 100 pounds of mixture.
- B. The fertilizer must be a uniform granular consistency of -8 to +16 mesh (with minimum of 85% retention), using the Tyler Standards, having a maximum allowable dust of five percent (5%) and packed in three (3)-ply laminated paper bags (or comparable).
- C. Fertilizer shall be delivered in unopened sacks, bearing the trade name, manufacturer's name, weight and analysis. Each delivery of fertilizer shall be accompanied by a delivery slip indicating the number of bags and the weight. The delivery slip shall be furnished to the Consultant or his agent at the time of delivery.
- D. Fertilizer shall not have been exposed to weather prior to delivery on the site, and after delivery, until used, it shall be completely protected at all times. It shall not be stored in direct contact with the ground. Any fertilizer that becomes caked or otherwise damaged, making it unsuitable for use, will not be accepted.

- E. The fertilizer shall be applied at a rate of twenty (20) pounds per 1000 square feet, or approximately 875 pounds per acre. The method of application for fertilizer shall be any method that uniformly and thoroughly incorporates the specified application into the two inches (2”) of the topsoil layer.
- F. The application of fertilizer shall not precede the performance of seeding by more than ten (10) days.

2.3 SEED

- A. Seed for use in the lawn areas shall be fresh material of the latest crop and shall be approved by Engineer.
- B. The contractor shall furnish to the engineer certificates stating that the seed he proposes to furnish complies with the foregoing requirements.
- C. Seed shall be delivered in standard size bags bearing the producers name, weight, and analysis. Seed supplied shall have been tested in the current year.
- D. Blend shall be Bluegrass Plus (Grand Prix) Mixture as follows:

<u>% of Mixture</u>	<u>Description</u>
30	Brooklawn Kentucky Bluegrass
20	Bluechip Kentucky Bluegrass
20	NuBlue Kentucky Bluegrass
15	Accent Perennial Ryegrass
15	Top Gun Perennial Ryegrass

2.4 MULCH

- A. Material for mulching seeded areas shall be unrotted small grain straw and binder of non-toxic biodegradable tackifier, as approved by the Engineer.

PART 3 EXECUTION

3.1 TOPSOILING

- A. The shredded-screened topsoil shall be uniformly blended with the approved sand in a ratio to provide a modified topsoil of a loamy sand texture consisting of 80-90% sand and five to ten percent (5-10%) silt and five to ten percent (5-10%), with a hydraulic conductivity of six to eight (6 to 8) in/hr. The specific ratio of sand to soil will be determined by the Engineer or its designated representative based upon sampling of any stockpiled and screened topsoil.
- B. Blending of the shredded – screened topsoil and sand shall be performed in a manner which will provide a uniform mixture conforming to the specified physical and chemical characteristics. Approval of the Topsoil Mix by the Engineer or its designated representative must be obtained prior to transportation and placement on the field. Under no circumstances shall any existing topsoil leave the jobsite without approval of the Engineer or its designated representative.

- C. Topsoil shall not be placed until the area to be topsoiled has been approved. All stones ½ inch or larger in any dimension, and other debris such as wires, cables, tree roots, pieces of concrete, clods and lumps shall be removed. If the surface to receive Topsoil has become compacted during construction operations, then the contractor must scarify the surface to provide an improved bond between the surface and topsoil. The topsoil shall be spread on a previously prepared surface in a uniform layer to produce the prescribed thickness.
- D. The Contractor shall allow in his/her bid for the application of pulverized limestone at a rate of 100 lbs. per 1,000 square feet to all topsoil, both imported and onsite materials.
- E. Topsoiled areas outside the limits of work shall be protected against damage caused by the delivery, handling, and/or storage of materials, by washouts due to drainage diversion, by workmen, or by equipment. Any such damage shall be replaced by grading, fertilizing, seeding and mulching at no additional cost to the Owner.
- F. Where either embankment or excavation slopes become eroded during the work and before acceptance, repairs shall be made at no additional cost to the Owner.
- G. The Contractor must modify a sufficient quantity of the shredded – screened topsoil to provide specified thickness (after settlement) of the Topsoil over the subgrade of the turf areas of the fields and sidelines.
- H. Topsoil shall not be placed until it has been screened and the area to be topsoiled has been approved. All stones 1/2 inch or larger in any dimension, and other debris such as wires, cables, tree roots, pieces of concrete, clods, and lumps shall be removed.
- I. Provide imported topsoil to meet material specifications. After spreading topsoil, rake up large stiff clods, hard lumps, roots, litter, other foreign matter and stones larger than 1/2” in greatest dimension. Remove from the premises or dispose where directed, in a satisfactory manner. Apply topsoil to lawn areas to provide four-inch (4”) depth of topsoil.
- J. No greater than one inch (1”) of depth shall be lost to natural settlement, picking of rocks and final preparation of seed beds. If any area is found to have lost greater than one inch (1”), additional topsoil shall be spread to raise depths to the original minimum depth.
- K. Fine grade and rake topsoiled areas to a smooth, uniform surface. Compact with an approved roller weighing approximately 500 pounds. Regrade and reroll until satisfactory grades as shown are obtained with the required depths of topsoil. Do not finish grade during unsuitable weather. If soil tests indicate organic matter content below the required levels, humus shall be applied to the surface of the spread topsoil and worked into the mix during raking operations. Apply quantity of organic amendments, either humus or mushroom compost, as necessary to meet the organic matter content specified. Submit soil test results demonstrating compliance with the requirements.
- L. Topsoil spreading shall be performed in such a manner that seeding can proceed with a minimum of additional soil preparation and tillage. Irregularities in the surface resulting from topsoiling or other operations shall be corrected in order to prevent the formation of depressions or crowns. Topsoil shall not be placed while the ground is frozen or muddy, or in a condition that may otherwise be detrimental to proper grading. After the topsoil has been spread and the final grade is established, the area shall be cleared of all grade stakes, surface trash and debris.

- M. The Contractor shall, wherever possible, conduct topsoiling immediately upon completion of approved subgrade preparation. The Contractor shall commence seeding, or other finished surfacing operations immediately upon completion of approved topsoil installation.
- N. In no case shall completed topsoiled field surfaces or lawn areas outside of field, which have been topsoiled, stand for more than two days prior to commencement of seeding.
- O. Excess topsoil which is not used on the job site shall be stockpiled and stabilized by the Contractor onsite or trucked offsite as directed by the Engineer.
- P. Any damage to seeded areas caused by pedestrian or vehicular traffic or other causes shall be repaired at no cost to the Owner.

3.2 PLANTING SEASON

- A. Seeding operations shall be carried out between April 1 to May 15th and August 15 to September 30. In no event shall seeding take place later than October 31 for non-field areas and no seeding shall be done on frozen ground or when the temperature is 32°F or lower. No changes or extensions of the above seeding periods will be made unless approved in writing by the Engineer.

3.3 SEED PREPARATION

- A. Provide fine grading, addition of soil amendments and raking as specified herein.

3.4 DRY APPLICATION METHOD OF LIME, FERTILIZER AND SEED

- A. Lime, seed, fertilizer and mulch shall be applied in dry form for all fields and margin areas. Lime shall be applied at the rate of 4,000 lbs. per acre (or as necessary to adjust soil pH to 6.0-6.5) and shall be applied separately and prior to fertilizing and seeding on prepared seedbeds.
- B. The lime shall be spread evenly and worked into the upper five to six inches (5 to 6”) of the soil after which the seedbed shall have the proper, smooth grade. Commercial fertilizer of analysis 10-20-10 as previously specified herein, shall be applied at the rate of between 600 and 800 pounds per acre. Apply the specified seed mix evenly at a rate of 300 pounds per acre immediately after fertilizing.

3.5 SEEDING METHOD

- A. For lawn areas, seed may be broadcast using cyclone type spreaders, drop spreaders or hydro-seeders. Seed shall be applied in two (2) perpendicular courses. After the seed has been properly applied, the seedbed shall be immediately mulched. Mulch seedbed as specified, to establish a uniform complete coverage and to ensure optimal moisture retention. Maintain optimal watering schedules throughout the seeding process.

3.6 MULCH SEEDED AREAS

- A. Spread mulch with a properly equipped mulcher blower, run by an experienced operator. Mulch shall be evenly spread to a uniform one to one and one-half inch (1 to 1½”) depth loose measurement and tacked in place.

3.7 ESTABLISHMENT PERIOD

- A. Provide watering of all lawn areas as required to promote growth. Until the project is substantially completed, and accepted by the Engineer, the Contractor shall be required to maintain all field turf between two to four inches (2" – 4") in height. (Depending upon prevailing weather conditions at the time of turf establishment, the Contractor may maintain longer shoot heights, providing that mowing operations remove no more than 1/3 the length of the shoot). The Contractor is required to repair or replace, or both, all seeding and mulching that is defective or becomes damaged. For the purpose of establishing compliance with the incentive clause described herein, for turf establishment, the Contractor shall maintain the seedbed, and seeding operation, including watering, fertilizing, re-seeding and mulching, until a uniform, vigorous stand of turfgrass, having a minimum seedling count of six (6) plants per square inch, uniformly distributed, is established to the satisfaction of the Engineer. Localized areas which must be re-seeded will be justification for withholding payment for this item, until entire area has been satisfactorily established.

3.8 GUARANTEE

- A. Seeded area shall obtain 100% coverage by the end of one (1) year, or two (2) full, growing seasons; or the Contractor shall reseed the areas. Replacement seeding shall be done not later than the proper planting season following the end of the guarantee period. All replacement seeded areas are subject to the same guarantee from the time they are seeded.

3.9 MAINTENANCE

- A. The Contractor's responsibility for maintenance shall be continuous until acceptance of the work. The Contractor shall submit a lawn maintenance schedule to the Engineer for review and approval no later than two (2) weeks after the award of the contract. Maintenance shall include, but not be limited to watering, reseeding, and reworking as follows:
1. Checking the seeded areas before watering to avoid excessive moisture.
 2. Refilling of rain-washed gullies and rutted areas.
 3. Reworking and reseeding of any areas which fail to show a uniform stand of grass.
 4. Weeding, cultivating, control of insects, fungus, and other diseases by means of spraying with an all-purpose insecticide and fungicide.
- B. Grass shall be mowed as many times as necessary during the maintenance period in order to maintain a maximum height of four inches (4") as measured from the top of the ground. No more than 1/3 of the grass height shall be removed during any one (1) mowing.

3.10 WATERING

- A. The Contractor shall maintain all new lawn areas including watering until date of substantial completion.

3.11 REFERTILIZATION

- A. At the completion of the second mowing, fertilize the grass with complete specified fertilizer at the rate of ten (10) pounds per 1,000 square feet.

3.12 RESEEDING

- A. Reseeding of any areas which fail to show a uniform stand of grass, shall be accomplished without additional cost to the Owner using originally specified materials and methods. Reseeding shall be repeated until all lawn areas are covered with a satisfactory stand of grass. A satisfactory stand of grass, as described above, shall be required.

3.13 CLEAN-UP

- A. The Contractor shall dispose of excess materials and debris, including but not limited to branches, paper, leaves, and rubbish resulting from this work.
- B. All areas shall be kept neat and clean and upon completion of work, the site shall be left in an orderly condition satisfactory to the Engineer.

3.14 APPROVAL AND ACCEPTANCE

- A. An inspection of turf shall be made by the Engineer 30 calendar days after completion of seeding and mulching on all fields. Calendar day count shall commence only after the total completion of all fields. Random test locations representative of the overall turf density shall be selected by the Owner's Landscape Architect based upon one test location per 15,000 square feet. Blade counts should be recorded for each test location. Criteria shall be met when all locations equal or exceed the minimal uniform plant count specified herein.
- B. The Seed Mix as specified herein shall be placed in all grass areas surrounding the facility disturbed by construction.

END OF SECTION

SECTION 333113
SITE SANITARY SEWERAGE GRAVITY PIPING

PART 1 GENERAL

1.1 DESCRIPTION

- A. This item shall consist of furnishing and installing gravity sanitary sewer lines of the diameter shown on the Plans, laid on a firm bed true to a line and grade in accordance with these Specifications. Limit of construction shall be five feet (5') from building structures unless otherwise indicated and conform to ten foot (10') horizontal and eighteen inch (18") vertical separation of water lines per requirements of NJAC 7:14A-23 as appropriate.

PART 2 PRODUCTS

2.1 PIPE MATERIALS

- A. The sewer pipe installed less than eleven feet (11') in depth shall be PVC plastic with integral wall bell and spigot joints and shall meet or exceed all applicable requirements of ASTM D3034, with a wall thickness class equal to SDR35. Pipe shall have a minimum modulus of elasticity of 400,000 PSI per ASTM D638, and a minimum pipe stiffness of 46 PSI per ASTM D2412 at 5% deflection. PVC cell classification shall be 12454B, 12454C, 12364C or 13364B as defined per ASTM D1784. Pipe joints shall comply with ASTM D3212 and have a gasket in conformance with ASTM F477.
- B. The pipe and fittings shall be homogeneous throughout and free of visible cracks, holes and foreign inclusions such as blisters, dents, or other injurious defects. The pipe shall be uniform in color, opacity, density, and other physical properties.
- C. All branches, bends, and accessories installed shall be as manufactured by the pipe supplier and shall have bell and spigot configurations comparable with that of the pipe. Tee-wye branches shall be used for building service connections where required. Fittings required to connect pipes of other materials shall be of the same manufacturer as the PVC pipe or an approved equivalent such as manufactured by Fernco, Inc.
- D. The lubricant used to assemble the PVC gravity sewer pipe shall be that supplied by the manufacturers of the pipe or an approved equivalent and shall have no detrimental effect on the gasket or on the pipe.
- E. Joints on pipe shall be push-on or approved equal.

2.2 COUPLING CONNECTION

- A. Connections between dissimilar pipe sizes and materials shall be made with couplings that have a shield for joint reinforcement. Standard stainless steel transition couplings shall be used for VCP to PVC connections.

PART 3 EXECUTION

3.1 GENERAL

- A. The Contractor shall excavate and backfill all trenches in accordance with the Details and protect all excavations that may be necessary for completing the work under the contract. Excavation shall be in open cut, except where and to such an extent as the Engineer may permit, authorize or require that the same be done by tunneling; and no extra compensation will be allowed for tunneling unless provided for in the bid item or negotiated by the Engineer. Trenches may be generally excavated and backfilled either by hand or by machinery as the Contractor may elect. The Contractor shall have no claims; nor will extra compensation be allowed due to the fact that hand excavation or backfill is required to protect adjacent properties or improvements.

3.2 REMOVAL AND STORAGE OF SURFACE MATERIALS

- A. The Contractor shall grub and clear the surface and remove all surface materials, and whatever nature, over the line of the trench.

3.3 REMOVAL OF OBSTRUCTIONS

- A. Water mains, storm drains, sanitary sewers, gas main, and other utilities are shown on the drawings in accordance with the best information available, for the information of the Contractor. Existing mains and services shall be carefully protected. The Contractor shall repair any damage to the satisfaction of the Engineer using materials of the kinds damaged at his own expense.
- B. It shall be the responsibility of the Contractor to notify all utilities, all pipe line owners and any other parties affected prior to the beginning of work.
- C. The Contractor shall, without extra compensation, break through and reconstruct, if necessary, the invert or arch of any sewer, culvert, or conduit that may be encountered if said structure is in such position, in the judgment of the Engineer, as not to require its removal, realignment, or complete reconstruction. This shall be done in such a manner as to not in any way interfere with the flow of water or other liquid that said sewer, culvert, or conduit is designed to carry.
- D. The Contractor shall not interfere with any persons, firms or corporations or with the Owner in protecting, removing, changing or replacing their pipes, conduits, poles or other structures; but shall suffer said persons, firms or corporations, or the Owner to take all such measures as they may deem necessary or advisable for the purpose aforesaid. The Contractor shall thereby be in no way relieved of any of his responsibilities under the Contract.
- E. In the event that the Owner has entered into any agreement with an affected utility owner or owners that will have an effect on the operations or financial responsibilities of the Contractor, the requirements of these stipulations will be inserted into the Special Provisions of the Contract.

3.4 WIDTH AND DEPTH OF TRENCHES

- A. Trenches shall be excavated to the necessary width and depth as may be shown on the drawings or Details or as directed. The trench subgrade shall be thoroughly compacted to provide a uniform and

continuous grade. Any part of the bottom of the trench excavated below the specified subgrade shall be corrected with approved material, thoroughly compacted.

- B. Where the bottom of the trench at subgrade is in unstable or unsuitable material, excavation shall be carried to such depth as ordered by the Engineer. The trench bottom shall be restored to subgrade with Select Backfill.
- C. The sides of the trenches shall be vertical to the top of the pipe and practically plumb above this point and under no circumstances will they be permitted to be sloped except with the approval of the Engineer. The trench width as indicated on the Details will be strictly adhered to as a maximum since this width affects the load bearing capacity of the pipe. Bell-holes shall be excavated in the bottom and sides of trenches to permit the proper making of joints.

3.5 LENGTH OF OPEN TRENCH

- A. Not more than one hundred and fifty (150) feet of trench shall be opened at any one time or location in advance of the completed placement of the pipelines, unless by written permission of the Engineer. The Engineer shall be empowered at any time to require the backfilling of open trenches over complete pipe lines if, in his judgment, such action is necessary; and the Contractor shall thereby have no claim for extra compensation, even though to accomplish said filling, he is compelled temporarily to stop excavation, or other work at any place.
- B. If work is stopped on any trench for any reason except by order of the Engineer, and the excavation is left open for an unreasonable length of time in advance of construction, the Contractor shall, if so directed, backfill such trench at his own cost, and shall not again open said trench until he is ready to complete the structure therein. If the Contractor shall refuse or fail to backfill such trench completely within forty-eight hours after said notice, the Engineer shall be authorized to do the work; and the Owner shall charge expense thereof to the Contractor and retain the same out of any monies due or to become due to him under the Contract.
- C. The excavation of all trenches shall be fully completed at least twenty feet in advance of pipe laying, unless otherwise authorized.

3.6 CLASSIFICATION OF EXCAVATION

- A. No classification will be made for materials excavated for the construction of sanitary sewers and manholes and payment for excavation will be included in the prices bid for items or at the fixed prices in the proposal and as defined in these Specifications.

3.7 PREPARATION OF PIPE EMBEDMENT

- A. The Contractor shall complete excavations in earth as nearly as practicable to the neat lines of the structures to be built therein. All irregularities and cavities, either in earth or rock excavation, in the bottom of trenches or tunnels, shall be filled to the required level with approved material, firmly compacted, before pipe lines are laid therein, and without extra compensation.

3.8 DEWATERING EXCAVATION

- A. It shall be the Contractor's complete responsibility to adequately control water that may be present in the excavation. He shall provide for the disposal of water removed from excavations, in such a manner not to cause damage to public or private property or to any portion of the work completed or in progress.

3.9 RESPONSIBILITY FOR CONDITION OF EXCAVATION

- A. The Contractor shall be responsible for the condition of all excavations made by him. All slides and caves shall be removed without extra compensation, at whatever time and under whatever circumstances they may occur.
- B. The neglect, failure or refusal of the Engineer to order the use of bracing or sheeting, or a better quality or larger sizes of timber, or to order sheeting, bracing or shoring to be left in place, or the giving or failure to give orders or directions as to the matter or methods of placing or driving sheeting, braces or shores, shall not in any way or to any extent relieve the Contractor of any responsibility concerning the condition of excavations or of any of his obligations under the Contract; or by any act of the Owner resulting in the keeping of any excavation open longer than would otherwise have been necessary, relieve the Contractor from the necessity of properly and adequately protecting the excavation from caving or slipping, nor from any of his obligations under the contract relating to injury of persons or property, nor entitle him to any claim for extra compensation.
- C. All open excavations shall be backfilled at the end of each workday such that no excavation is left open and unattended until the start of work the next day.

3.10 OWNERSHIP OF EXCAVATION MATERIAL

- A. The Contractor shall have no property right in any material taken from any excavations, and shall not remove any earth, sand, or other material from the site or the work, except upon direction of written permission of the Engineer.

3.11 BACKFILLING

- A. The Contractor shall backfill all excavations as rapidly as practicable after the completion of structural work therein or after the excavations has served their purpose. All unauthorized excavations made by the Contractor shall be immediately backfilled at the Contractor's cost.
- B. In areas to remain unpaved, backfill material above the bedding material shall consist of clean earth, free of ashes, putrescible refuse, large stones or other material of an unsatisfactory character as may be determined by the engineer. Backfilling of the trenches shall be commenced by depositing and compacting suitable material in layers not more than twelve inches (12") thick, measured loose, over the pipe to point not less than one foot (1') nor more than two feet (2') in depth over the top thereof, after which backfilling of the remainder of the trench with stones of not more than six inches (6") in their largest dimensions which have been taken out in excavating may be mixed with the earth in the backfill in an amount of not over 25%, if the Engineer shall so approve, in eight inch (8") layers. Stones of large size or in greater quantities shall not be used, unless specified or directed by the Engineer. In areas to be paved, backfilling of the trenches shall be commenced by depositing and compacting dense graded aggregate in layers not more than twelve inches (12") thick, measured loose,

above the bedding material. The Contractor shall not permit excavations to be used for the disposal of refuse. All sanitary sewer lines to have a cover as specified in the contract drawings.

- C. No connections, branches, fittings, of any character, or any part of a pipe line or other structure that needs to be located or measured shall be filled over or around until the required measurements have been made by the Engineer; and his permission so to do has been given and any such that are covered without authorization shall be uncovered by the Contractor at his own expense.
- D. The backfilling of trenches which have been cut shall be performed in such a way as to give the backfilled trench a compaction density of 95% as determined by the AASHTO Methods, Compaction and Density of Soils T-180, Method A.
- E. The Engineer may at any time, when excavated or backfill material changes character or consistency, require the Contractor to revise his backfill methods accordingly in order to achieve the required compaction requirements. Backfilling of the trench around the pipe shall be as specified heretofore.
- F. After the completion of backfilling, all materials not used therein shall be removed and disposed of in such a manner at such point or points as shall be approved or directed. Said clean up shall be done by the Contractor without extra compensation; and if he shall fail to do such work within reasonable time after receipt of notice, cleanup will be performed by the Owner; and the cost shall be retained out of the monies due or to become due to the Contractor under the contract.
- G. Should unsuitable material be encountered in the excavation of the trench, the Contractor shall at his own expense remove and dispose of such unsatisfactory materials at a disposal facility to be found by the Contractor. The Contractor shall procure and substitute suitable approved material. Placing the select material and disposal of the unsuitable material will be at no cost to the owner. Any unsatisfactory material that is excavated outside the specified width of trench shall be removed and disposed of and suitable approved material shall be substituted at the Contractor's expense. Unsuitable material may be construed as clay, material that will not crumble under light hand pressure, frozen materials, ashes, putrescible or other refuse and other material that will not compact readily. Suitable material shall be construed as material of a classification that will compact readily when the approved method of backfilling is used.
- H. All surplus suitable material excavation from the pipe trenches shall be available for use in replacing unsuitable material that may be excavated elsewhere within the limits of the work. The cost of hauling, storage, or reuse of surplus suitable excavated material shall be included in the overall cost of the project and no separate payment will be made.
- I. Special Backfill Material shall be obtained only when surplus suitable material is not available as determined by the Engineer.

3.12 MAINTENANCE OF BACKFILLED EXCAVATION

- A. The Contractor shall maintain, at his own expense, all backfilled excavations in proper condition until the end of the one-year period following the date of final payment. All depressions appearing in the backfilled excavations shall be properly backfilled. If the Contractor shall fail to do so within a reasonable time after the receipt of written notice from the Engineer, the Engineer may backfill said depressions; and the cost thereof shall be deducted from any monies due or to become due the Contractor under the contract. In case of emergency, the Engineer may backfill any dangerous depression without giving previous notice to the Contractor; and the cost of so doing shall be retained from any monies due, or to become due the Contractor.

- B. The Contractor shall be responsible for any injury or damage that may result from improper maintenance of any backfilled excavation at any time previous to the end of the one-year maintenance period.
- C. The Contractor will be required to furnish to the Engineer the names, addresses, and telephone numbers of at least two members of his organization that may be contacted in an emergency, 24 hour per day, 7 days per week.

3.13 ROCK EXCAVATION

- A. Whether or not rock is shown on the plans, the Contractor is not relieved of the responsibility of making his own investigation to determine for himself if rock is present and in what quantity. The presence or absence of rock, or the increase or decrease in quantities of rock indicated, shall not entitle the contractor to additional compensation above or beyond the lump sum bid.
- B. Unless otherwise directed, rock shall be fully taken out at least 25 feet in advance of the laying of pipe, to a point directly under the pipe, six inches (6") below the outer bottom, and to the width over the outside of the pipe (exclusive of bells) on each side as stated in width and depth of trenches. Rock shall be sufficiently removed at joints so that they may be properly made.
- C. Rock appearing in miscellaneous excavation, tunnels or where future pipes are to connect with those laid under the contact, shall be excavated in accordance with the directions of, and to the lines prescribed by the Engineer.

3.14 BRACING OR SHEETING

- A. The Contractor shall support the sides and ends of all excavations wherever necessary or directed with braces, sheeting, shores, or stringers of the quality and character as directed. All timbering shall be put in place or driven by men skilled in such work and shall be so arranged that it may be withdrawn as backfilling proceeds, without injury to the structure built under the contract or to any road bed or adjacent structures, or property. If in the opinion of the Engineer the material furnished for timbering excavations is not of proper quality or sufficient size or not properly placed to ensure the safety of the work or of adjacent structures or property, the Contractor shall upon notice forthwith procure and place satisfactory timbering, or place said timbering in a satisfactory manner; and upon his failure to do so, the work may be ordered stopped until said notice shall have been complied with and without entitling the Contractor to any claim for extra compensation, damage or delay.
- B. All timbering in excavations shall be withdrawn as the backfilling is being done, except where and to such extent as the Engineer shall order in writing that said timbering be left in place or where he shall permit the same to be left in place at the Contractor's expense and upon his request. The Contractor shall cut off any sheeting left in place, at least 18-inches below finished grade. There will be no additional compensation for cutting and removing this material.
- C. Wherever necessary in quicksand or soft ground or for the protection of any structure or property, sheeting shall be driven without extra compensation to such a depth below the bottom of the trench as may be required or directed.

3.15 PROTECTION OF PROPERTY AND STRUCTURES

- A. The Contractor shall at his own expense sustain in their places and protect from direct or indirect injury all pipes, poles, tracks, walls, buildings, and other structures or property in the vicinity of his work whether above or below the ground, or what may appear in the trench. He shall at all times have a sufficient quantity of timber and plank, chains, ropes, etc., on the site and shall use them as necessary for sheeting his excavations and for sustaining or supporting any structures that are uncovered, undermined, endangered, threatened or weakened. The Contractor shall take all risks attending the presence or proximity of pipes, poles, tracks, walls, buildings, and other structures and property of every kind and description in or over his trenches or in the vicinity of his work whether above or below the surface of the ground; and he shall be responsible for all damage and assume all expense for direct or indirect injury caused by his work to any of them or to any person or property by reason of injury to them, whether such structures are or are not shown on the drawings.

3.16 LAYING PIPE

- A. Pipe and fittings shall be carefully handled and lowered into the trench. The ends of pipe shall meet each other in such a manner that there shall be no shoulder or unevenness on the inside of the main. Special care shall be taken to ensure that the pipes are well bedded on a solid foundation. The Contractor shall correct any defects due to settlement at his own expense. Bell holes shall be dug sufficiently large to ensure the making of proper joints. Special precautions shall be exercised to prevent any pipe from resting on rock.
- B. Proper and suitable tools and appliances for the safe and convenient handling and laying of pipes and fittings shall be used. Great care shall be taken to prevent the pipe lining and coating from being damaged. The Contractor shall repair any damaged lining or coating to the satisfaction of the Engineer. If the lining or coating cannot be repaired to the satisfaction of the Engineer, the damaged pipe shall be replaced at the Contractor's expense.
- C. The pipes and fittings shall be thoroughly cleaned before they are laid and shall be kept clean until the acceptance of the completed work. The pipe or fitting, after being thoroughly cleaned, shall then be carefully lowered into the trench so as to exclude dirt and other foreign substances, and after it has been inserted per the manufacturer's recommendations, the end shall be kept closed with a tight stopper until the next length is laid. At the close of work each day, the end of the pipe line shall be tightly closed with an expansion stopper so that no dirt or other foreign substances may enter the line, and this stopper shall be kept in place until pipe laying is again resumed.
- D. Whenever a pipe requires cutting to fit in the line or to bring it to the required location, the work shall be done in a satisfactory manner so as to leave a smooth end. Deflecting of pipe joints shall be limited to that shown in the Drawings. Deflecting of pipe joints not listed in the Drawings will be in accordance with the manufacturer's printed recommendation, subject to the approval of the Engineer.

3.17 JOINTING PIPE

- A. Before any joints are actually made in the trench, the Contractor shall demonstrate to the Engineer by making a sample joint that the methods which he will employ conform with the Specifications and will secure a watertight joint and that the workmen he intends to use in this work are familiar with the requirements.

3.18 GRAVITY SEWER DEFLECTION TESTING

- A. The Contractor shall furnish all equipment and labor to conduct deflection testing on twenty (20%) percent of all installed sewer pipe. The total vertical wall deflection of the PVC sewer pipe shall not exceed seven and one-half percent (7.5 %) of the inside pipe diameter. Deflection testing shall not be conducted earlier than seven (7) days after placement and compaction on the backfill. In addition, the Contractor shall make provisions so that the groundwater level is kept below the invert of the pipe during the testing.
- B. The vertical deflection shall be checked by manually pulling a go, no-go deflection testing mandrel through the pipe. The mandrel shall be specifically design for this purpose and the Contractor shall submit details of the mandrel to the Owner prior to use. The mandrel shall be as manufactured by Armco, Inc. or approved equal and shall have the specified accuracy in all positions of rotation.
- C. The Contractor shall perform all deflection testing in the presence of the Owner. Should any pipe section exceed the maximum deflection specified, the Contractor shall furnish necessary remedial work to reduce the deflection to an allowable limit to the satisfaction of the Owner.

3.19 INFILTRATION/EXFILTRATION TESTING

- A. Test Criteria
 - 1. Air test shall allow minimum amount of time for pressure inside pipe to drop from 3.5 PSIG to 3.0 PSIG as a function of pipe size.
 - 2. The allowable time for a loss of 0.5 PSIG at an average pressure of 3.0 PSIG shall exceed 3 min. 47 sec. for 8-inch dia./100 LF
 - 3. The Contractor shall make necessary corrections to the satisfaction of the Engineer and in compliance with the above until such time as these specifications are met.
- B. Low Pressure Air Test Alternate
 - 1. The section to be tested shall be between consecutive manholes in accordance with ASTM F1417.
 - 2. Each end of pipe, all branches, laterals, and wyes shall be plugged and securely braced. The plug at each end of pipe shall have provision to connect an air hose. Air shall be supplied to the section and monitored so as not to exceed 5.0 PSIG.
 - 3. An independent air gage and line shall be installed on the opposite plug to the air supply such that the gage can be read at the ground surface.
 - 4. The air pressure shall be maintained between 4.0 and 3.5 PSIG for at least two minutes to allow air temperature to come to equilibrium with pipe walls.
 - 5. The air supply shall then be disconnected and the air pressure allowed to decrease to 3.5 PSIG. At 3.5 PSIG the time shall be measured for the pressure to drop to 3.0 PSIG.
- C. Defects to Be Made Good
 - 1. If, at any time before the completion of the contract, any broken pipes, or any defects, are found in the sewer lines or in any of their appurtenances, the Contractor shall cause the same to be removed and replaced by proper materials and workmanship, without extra compensation for the labor and material required, even though such injury or damage may not have been due to any act, default, or negligence on the part of the Contractor; provided however, that should such defective work result from inherent flaws in the material furnished by the Owner, materials to replace same will be furnished by the Owner. The Contractor shall examine all materials for defects just before placing. Any defective material shall not be placed into any portion of the Work.

END OF SECTION