RENOVATION & SYSTEM UPGRADES – PHASE 2
PARKVIEW MIDDLE SCHOOL
ANKENY COMMUNITY SCHOOL DISTRICT
ANKENY, IOWA

PROJECT NUMBER: 1023F01
DATE: MARCH 2020
PROJECT MANUAL

FOR

RENOVATION & SYSTEM UPGRADES - PHASE 2

PARKVIEW MIDDLE SCHOOL
ANKENY COMMUNITY SCHOOL DISTRICT
ANKENY, IOWA

PROJECT NUMBER: FRK-1023F01

DATE: MARCH 2020

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I hereby certify that the portion of this technical submission described below was prepared by me or under my direct supervision and responsible charge. I am a duly licensed architect under the laws of the state of Iowa.

signature  Thomas C. Wollan  date
License Number: 5545
My license renewal date is June 30, 2021
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I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.

signature  Brian R. Bartlett, P.E.  date
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(KCL-E)
This Manual follows the Uniform System. Numerical-Alphabetical Designations are used herein. Sections not used are not shown.

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END OF LIST OF DRAWING SHEETS

FRK-A and FRK- S - frk architects + engineers
KCL-M and KCL-E - KCL Engineering
NOTICE TO BIDDERS

NOTICE IS HEREBY GIVEN: Sealed bids will be received by the Board of Directors of the Ankeny Community School District at the District Administration Offices, 306 SW School Street, Ankeny, Iowa 50023, until 2:00 PM local Iowa time, according to the designated clock in the District Administration Offices, on March 31, 2020 for the Phase 2 Renovation & System Upgrades at Parkview Middle School located in Ankeny, IA. Bids will be publicly opened and read aloud after 2:00 PM in the District Administration Board Room. All in accordance with the plans and specifications on file at the District Administrative Offices and available after February 28, 2020 as follows:

Project Architect/Engineer: Project Owner:
frk architects + engineers Ankeny Community School District
2600 Westown Parkway, Suite 340 306 SW School Street
West Des Moines, IA 50266 Ankeny, IA 50023
Phone: 515-223-5100 Phone: 515-289-3958
Fax: 515-223-7226

Lump-sum bids will be received for General Construction including Mechanical and Electrical Construction the project that consists of interior renovation and refinishing and building mechanical and electrical system upgrades.

Construction may begin on or after the 1st day of June, 2020 following Owner receipt and approval of required Bonds and Insurance. The Owner requires that Project be Substantially Complete on or before the 21st day of August, 2020.

A Pre-Bid Conference will be held at 10:00 AM on the 16th day of March, 2020 at Parkview Middle School in the Performance Center Room 126 located at 105 NW Pleasant Street, Ankeny, IA 50023.

Bidding Documents may be examined online at www.beelineandblue.com and at:
  Austin MN: Austin Builders Exchange, 329 N. Main Street, #102.
  Des Moines IA: Dodge Data. Digital plan room only.
  Des Moines IA: Master Builders of Iowa. Digital plan room only.
  LaCrosse WI: LaCrosse Builders Exchange. Digital plan room only.
  Mason City IA: North Iowa Builders Exchange, 25 West State Street.
  Minneapolis MN: Minnesota Builders Exchange, 1123 Glenwood Ave.
  Norcross, GA: Reed Construction Data. Digital plan room only.
  Omaha NE: Omaha Builder's Exchange. Digital plan room only.
  Rochester MN: Builders Exchange of Rochester, 108 Elton Hills Lane NW.
  Sioux City IA: Sioux City Construction League, 3900 Stadium Drive.
Copies of the Bidding Documents may be obtained from Beeline + Blue, 2507 Ingersoll Avenue, Des Moines, Iowa 50312, 515-244-1611 upon receipt of a refundable deposit, by cash or check in the amount of $100, or receipt of Master Builders Plans Request Card, for one set.

Any Bidder, upon returning the documents in good condition within 10 days of the public opening of bids, shall be returned the deposit in full.

Bid Security in the amount of five percent (5%) of the Bid must accompany each Bid in accord with the Instructions to Bidders. The successful Bidder will be required to furnish a Certificate of Insurance and Performance and Labor and Material Payment Bonds both in an amount equal to 100% of the Contract Price and in accordance with other requirements outlined in the Bid Documents.

Minority and Targeted Small Business participation is encouraged. Bidders shall make a good faith documented effort to encourage the participation of Certified Iowa Targeted Small Business in accordance with the Code of Iowa.

By virtue of statutory authority, preference will be given to products and provisions grown and/or produced within the State of Iowa, and preference will be given to Iowa domestic labor as provided in the Code of Iowa.

The Owner reserves the right to reject any or all Bids and to waive informalities or irregularities in the bidding.

By order of the Board of Education

Ankeny Community School District
Ankeny, IA

By: Lori Lovstad, Board President
Attest: Jennifer Jamison, CFO, Board Secretary/Treasurer

END OF DOCUMENT
NOTICE OF PUBLIC HEARING

Public notice is hereby given that at 5:00 p.m. Central Time on Monday February 17, 2020, in the Board Room of the Ankeny Community School District, 306 SW School Street, Ankeny, Iowa, there will be a public hearing on the proposed plans, specifications, form of contract, and estimated cost of the Parkview Middle School Renovation & Systems Upgrade – Phase 2 Project.

The Project, which is located at 105 NW Pleasant St, Ankeny, IA, involves the construction activities as required by the contract documents which shall include:

   Interior renovation of existing spaces and mechanical, plumbing and electrical system upgrades to building systems.

Published by order of the Board of Directors, Ankeny Community School District, Ankeny, Iowa.

By:       Lori Lovstad, Board President

Attest:   Jennifer Jamison, CFO, Board Secretary/Treasurer

END OF DOCUMENT
INSTRUCTIONS TO BIDDERS

1. SUMMARY

1.1 SUMMARY

A. Document Includes:
   1. Bid submission.
   2. Intent.
   3. Work identified in contract documents.
   5. Definitions.
   7. Availability of documents.
   8. Examination of documents.
   9. Inquiries and Addenda.
  11. Site examination.
  15. Submission procedure.
  16. Bid ineligibility.
  17. Security deposit.
  19. Bid Form requirements.
  20. Fees for changes in the Work.
  23. Bid opening.
  24. Duration of offer.
  25. Acceptance of offer (award).

B. Related Sections:
   1. Document 00 11 13 - Notice to Bidders.
   3. Document 00 41 00 - Bid Forms.
4. Document 00 73 00 - Supplementary Conditions.
   a. Definitions.
   c. Tax exempt procedures.
   d. Contractor’s fees for changes.
   e. Contractor’s liability insurance.
   f. Bond types and values.

1.2 **BID SUBMISSION**

A. Bids signed and under seal, executed, and dated will be received by the Owner at time, location, and date indicated in Notice to Bidders.

B. Bids submitted after the above time shall be returned to the bidder unopened.

C. Amendments to submitted Bids will be permitted when received in writing prior to bid closing and when endorsed by the same party or parties who signed and sealed the Bid.

D. Bidders may withdraw their Bids by written request at any time before bid closing.

1.3 **INTENT**

A. The intent of this Bid request is to obtain an offer to perform Parkview Middle School Renovation & System Upgrades - Phase 2 Work for a Stipulated Sum contract, in accordance with Contract Documents.

1.4 **WORK IDENTIFIED IN THE CONTRACT DOCUMENTS**

A. Work of this proposed Contract comprises general construction, renovation, and mechanical and electrical Work.

B. Location: Parkview Middle School, 105 NW Pleasant Street, Ankeny, IA 50023.
1.5 CONTRACT TIME

A. Perform the Work within time stated in Document 00 41 00 and Section 01 11 00. The Bidder, in submitting an offer, accepts the Contract Time period stated for performing the Work.

1.6 DEFINITIONS

A. Bid Documents: Contract Documents supplemented with Notice to Bidders, Instructions to Bidders, Bid Form, and Bid securities identified.


C. Bid: Executed Bid Form and required attachments submitted in accordance with these Instructions to Bidders.

D. Bid Price/Sum: Monetary sum identified by the Bidder in the Bid Form.

1.7 CONTRACT DOCUMENTS IDENTIFICATION

A. The Contract Documents are identified as Project number FRK/1023F01 as prepared by the Architect/Engineer and identified in the Project Manual.

1.8 AVAILABILITY OF DOCUMENTS

A. Bidding Documents may be obtained as stated in Notice to Bidders.

B. One set of Bidding Documents can be obtained by Bidders upon receipt of a refundable deposit, by cash or check in the amount identified in the Notice to Bidders.

C. Partial sets of Bidding Documents will not be issued to Bidders.

D. Deposit will be refunded if Bidding Documents are returned complete, undamaged, unmarked and reusable, within 10 days of bid opening. Failure to comply will result in forfeiture of deposit.
E. Bidding Documents are made available only for the purpose of obtaining offers for this Project. Their use does not grant a license for other purposes.

1.9 EXAMINATION OF DOCUMENTS

A. Bid Documents are on display at the offices of the construction association plan room facilities indicated in Notice to Bidders.

B. Upon receipt of Bidding Documents verify documents are complete. Notify Architect/Engineer if documents be incomplete. If using any of the listed plan rooms or online plan services listed in Notice to Bidders, or any other online plan service, Contractor shall verify they have complete documents based on those posted on official printers website.

C. Immediately notify Architect/Engineer upon finding discrepancies or omissions in Bidding Documents.

1.10 INQUIRIES AND ADDENDA

A. Direct questions in writing to the Architect/Engineer.

B. Verbal answers are not binding on any party.

C. Submit questions not less than 7 days before date set for receipt of Bids. Replies will be made by Addenda.

D. Addenda may be issued during bidding period. Addenda will be sent to known Bidders and construction association plan room facilities. Addenda become part of the Contract Documents. Include resultant costs in the Bid Price/Sum.

1.11 PRODUCT SUBSTITUTIONS

A. Where Bidding Documents stipulate particular Product, substitution requests will be considered by Architect/Engineer up to 10 days before receipt of Bids.

B. With each substitution request, provide sufficient information for Architect/Engineer to determine acceptability of proposed products.
C. When a request to substitute a Product is made, Architect/Engineer may approve the substitution. Approved substitutions will be identified by Addenda.

D. In submission of substitutions to Products specified, Bidders shall include in their Bid, changes required in the Work and changes to Contract Time and Contract Sum/Price to accommodate such approved substitutions. Later claims by the Bidder for an addition to the Contract Time or Contract Sum/Price because of changes in Work necessitated by use of substitutions shall not be considered.

1.12 SITE EXAMINATION

A. Examine Project site before submitting a Bid.

B. Contact Owner at the following phone number to arrange a date and time to visit Project site:
   1. Contact: Tim Simpkins.
   2. Telephone: 1-515-289-3958

C. Currently occupied premises at Project site are open for examination by Bidders only during the following hours:
   1. Monday through Friday: 8:00 AM to 4:00 PM.
   2. Weekends: None.

1.13 PREBID CONFERENCE

A. A Prebid Conference is scheduled, as indicated in Notice to Bidders.

B. General contract and major subcontract Bidders are invited to attend.

C. Representatives of the Owner, Architect/Engineer, and Consultants will be in attendance.

D. Information relevant to the Bidding Documents will be issued by Addenda.
1.14 **BIDDER QUALIFICATIONS**

A. To demonstrate qualification for performing the Work of this Contract, Bidders may be requested to submit written evidence of financial position, current commitments, and license to perform work in the State of Iowa.

1.15 **SUBCONTRACTORS**

A. The Owner reserves the right to reject a proposed Subcontractor for reasonable cause.

B. Refer to AIA Document A201-2017, Article 5 of General Conditions.

1.16 **SUBMISSION PROCEDURE**

A. Bidders shall be solely responsible for the delivery of Bids in manner and time prescribed.

B. Submit one copy of executed offer on the Bid Form provided, signed and sealed in a closed opaque envelope, clearly identified with Bidder's name, Project name, and Owner's name on the outside.

C. Double Envelope: Insert closed and sealed Bid Form envelope plus requested security deposit in a large opaque envelope and label this envelope as noted above.

D. Improperly completed information, irregularities in security deposit, shall be cause not to open the Bid Form envelope and declare the Bid invalid or informal.

E. An abstract summary (bid tab) of submitted Bids will be made available to all Bidders following bid opening.

1.17 **BID INELIGIBILITY**

A. Bids that are unsigned, improperly signed or sealed, conditional, illegible, obscure, contain arithmetical errors, erasures, alterations, or irregularities of any kind, shall be declared unacceptable at Owner's discretion.
B. Bid Forms and enclosures which are improperly prepared shall be declared unacceptable at Owner’s discretion.

C. Failure to provide security deposit, bonds, or insurance requirements shall invalidate the Bid at the discretion of the Owner.

1.18 SECURITY DEPOSIT

A. Bids shall be accompanied by a security deposit of a sum no less than 5 percent of Bid Sum/Price. Security deposit shall be one of the following:
   1. AIA Document A310-2010, Bid Bond.
   2. Cashier’s check.
   3. Certified check.
   4. Certified share draft.

B. Endorse Bid Bond in name of the Owner as obligee, signed and sealed by principal (Contractor) and surety authorized to do business in the State of Iowa.

C. Endorse cashier’s check, certified check, or certified share draft in name of the Owner.

D. Security deposit of accepted Bidder will be returned after delivery to the Owner of the required Performance and Payment Bonds by the accepted Bidder.

E. Include the cost of security deposit in the Bid Sum/Price.

F. After a Bid has been accepted, security deposits will be returned to the respective Bidders.

G. If no contract is awarded, security deposits will be returned.

1.19 PERFORMANCE ASSURANCE

A. Accepted Bidder: Provide a Performance and Payment bond as described in Document 00 73 00.

B. Include the cost of performance assurance bonds in the Bid Sum/Price and identify the cost when requested by Owner.
1.20 BID FORM REQUIREMENTS

A. Complete requested information in the Bid Form and Appendices.

B. Refer to Document 00 73 00 - Supplementary Conditions for tax exempt procedures.

1.21 FEES FOR CHANGES IN THE WORK

A. Include fees for overhead and profit on Bidder’s own Work and Work by Subcontractors, identified in Document 00 73 00 - Supplementary Conditions.

1.22 BID FORM SIGNATURE

A. Sign Bid Form, as follows:
   1. Sole Proprietorship: Signature of sole proprietor in the presence of a witness who will also sign. Insert the words "Sole Proprietor" under the signature. Affix seal.
   2. Partnership: Signature of all partners in the presence of a witness who will also sign. Insert the word "Partner" under each signature. Affix seal to each signature.
   3. Corporation: Signature of a duly authorized signing officer(s) in their normal signatures. Insert the officer’s capacity in which the signing officer acts, under each signature. Affix the corporate seal. If the bid is signed by officials other than the president and secretary of the company, or the president/secretary/ treasurer of the company, a copy of the by-law resolution of their board of directors authorizing them to do so, must also be submitted with the Bid Form in the bid envelope.
   4. Joint Venture: Each party of the joint venture shall execute the Bid Form under their respective seals in a manner appropriate to such party as described above, similar to the requirements for Partnership.

1.23 TARGETED SMALL BUSINESS

A. Program Description:
   1. Owner seeks to provide opportunities for Certified Iowa Targeted Small Businesses in the award of all contracts in accordance with State of Iowa requirements.
   2. Certified Iowa Targeted Small Business participation target for Project is ten percent of Bid.

B. Definitions:
1. Certified Iowa Targeted Small Business: Small business, fifty-one percent or more owned, operated, and actively managed by one or more women or minority persons.
2. Certified: Targeted Small Business shall be certified by the Iowa Department of Inspections and Appeals.
3. Small Business: Enterprise which is located in the State of Iowa, operated for profit under a single management, and has an annual gross income of less than three million dollars computed as the average of the three preceding fiscal years.
5. Actively Managed: Exercising the power to make policy decisions affecting the business.
6. Operated: Actively involved in the day-to-day management of the business.

1.24 BID OPENING

A. Bids will be opened publicly immediately after time for receipt of Bids. Bidders may be present.

1.25 DURATION OF OFFER

A. Bids shall remain open to acceptance and shall be irrevocable for a period of 30 days after bid closing date.

1.26 ACCEPTANCE OF OFFER (AWARD)

A. It is the intent of the Owner to award a Contract to the lowest responsive, responsible Bidder provided the Bid has been submitted in accordance with the requirements of the Bidding Documents. The Owner shall have the right to waive informalities and irregularities in a Bid received and to accept the Bid which, in the Owner’s judgement, is in the Owner’s own best interest.

B. The Owner reserves the right to accept or reject any or all offers.
C. After acceptance by the Owner, the Architect/Engineer on behalf of the Owner, will issue to the accepted Bidder, a written letter of Contract Award.

D. The accepted Bidder shall assist and cooperate with the Owner to prepare the Agreement, and within 7 days following its presentation shall execute Agreement and return it to the Architect/Engineer for delivery to the Owner.

END OF DOCUMENT
DOCUMENT 00 31 00

AVAILABLE PROJECT INFORMATION

1. SUMMARY

A. Document Includes:
   1. Asbestos testing survey.

B. Related Documents:
   1. Document 00 21 13 - Instructions to Bidders: Site examination.

2. ASBESTOS TESTING SURVEY

A. A copy of an asbestos testing survey with respect to the project site is available for viewing at the office of the Owner during regular business hours.

B. This survey shall not be construed as a requirement of this Contract, nor part of the Contract Documents.

C. This survey, by its nature, cannot reveal all conditions that exist on the site. Should suspect materials be encountered Contractor shall notify Owner for investigation and removal.

D. Contractor shall assume responsibility for conclusions they draw from survey. They may employ their own experts to analyze available information, and shall be responsible for any conclusions drawn from that additional source.

END OF DOCUMENT
DOCUMENT 00 41 00

BID FORMS

To: Board of Education
Ankeny Community School District
Ankeny, IA

Project: Parkview Middle School
Renovation & System Upgrades - Phase 2
Ankeny, IA.

Date: _______________

Submitted by: ___________________________ (Contractor)
_______________________________ (Address)
_______________________________ (City/State/Zip Code)
_______________________________ (Telephone/Fax)

1. OFFER

Having examined the Place of the Work and all matters referred to in the Instructions to Bidders and the Contract Documents prepared by the Architect/Engineer for the above mentioned project, we, the undersigned, hereby offer to enter into a Contract to perform the Work for the Sum/Price of:

_______________________________ Dollars ($_________________________),

in lawful money of the United Stated of America.

We have included the required Bid security as required by the Instructions to Bidders.

All applicable Federal, State, and City taxes are included in the Bid Sum, excluding Iowa Sales tax.

Contingency Allowance in amount of $75,000, and further described in Section 01 20 00 - Price and Payment Procedures is included in the Bid Sum.
2. **ACCEPTANCE**

This offer shall be open to acceptance and is irrevocable for thirty days from the bid closing date.

If this bid is accepted by the Owner within the time period stated above, we will:

- Execute the Agreement within ten days of receipt of Notice of Award.
- Furnish the required Bonds and Insurance Certificates within ten days of receipt of Notice of Award in the forms described in Bonds and Certificates and Supplementary Conditions.
- Commence the work within ten days of receipt of Notice to Proceed, or if no Notice to Proceed is issued, the date of the Agreement.

If this bid is accepted within the time stated, and we fail to commence the Work or we fail to provide the required Bonds or Insurance Certificates, the security deposit shall be forfeited as damages to the Owner by reason of our failure, limited in amount to the lesser of the face value of the security deposit or the difference between this bid and the bid upon which a Contract is signed.

In the event our bid is not accepted within the time stated above, the required security deposit shall be returned to the undersigned, in accordance with the provisions of the Instruction to Bidders; unless a mutually satisfactory arrangement is made for its retention and validity for any extended period of time.

3. **CONTRACT TIME**

If this Bid is accepted, we will:

- Complete Work on or before the 21st day of August, 2020.
4. ADDENDA

The following Addenda have been received. The modifications to the Bid Documents noted below have been considered and all costs are included in the Bid Sum.

Addendum Number _______, Dated ________.

Addendum Number _______, Dated ________.

Addendum Number _______, Dated ________.

Addendum Number _______, Dated ________.

Addendum Number _______, Dated ________.

Addendum Number _______, Dated ________.

Addendum Number _______, Dated ________.

5. APPENDICES

The following documents are attached to and made a condition of the Bid:

Appendix A - Targeted Small Business.
Appendix B - Bidder Status Form
6. BID FORM SIGNATURE(S)

Respectfully submitted this _____ day of _____, 20_____.

The Corporate Seal of

__________________________________________________________
(Bidder - Print the full name of your firm)

was hereunto affixed in the presence of:

__________________________________________________________
(Authorized signing officer Signature) (Title)
(Seal)

__________________________________________________________
(Authorized signing officer Signature) (Title)
(Seal)

If the Bid is a joint venture or partnership, add additional forms of execution for each member of the joint venture in the appropriate form or forms as above.

END OF DOCUMENT
APPENDIX A - TARGETED SMALL BUSINESS

Herewith is the list of Certified Iowa Targeted Small Business' referenced in the bid submitted by:

(Bidder) __________________________

(Owner) Ankeny Community School District, Ankeny, IA

Dated _______, 20____ and which is an integral part of the Bid Form.

The following Targeted Small Business' were contacted, and if bid is accepted by the Owner, will perform or provide the following work described below. Refer to Section 00 21 13 - Instructions to Bidders: Targeted Small Business.

1. __________________________________________________________________________
   (Name of Targeted Small Business)

   __________________________________________________________________________
   (Address)

   __________________________________________________________________________
   (Contact Person) ___________________ (Telephone Number)

   $ ________________________________
   (Work Description) ____________ (Dollar Amount)

2. __________________________________________________________________________
   (Name of Targeted Small Business)

   __________________________________________________________________________
   (Address)

   __________________________________________________________________________
   (Contact Person) ___________________ (Telephone Number)

   $ ________________________________
   (Work Description) ____________ (Dollar Amount)
3. (Name of Targeted Small Business)

(Address)

(Contact Person) (Telephone Number)

($) (Dollar Amount)

The following Targeted Small Business’ were contacted, and declined to participate:

1. (Name of Targeted Small Business)

(Address)

(Contact Person) (Telephone Number)

(Reason for Declining) (Date Contacted)

2. (Name of Targeted Small Business)

(Address)

(Contact Person) (Telephone Number)

(Reason for Declining) (Date Contacted)
3.

(Name of Targeted Small Business)

(Address)

(Contact Person) (Telephone Number)

(Reason for Declining) (Date Contacted)
**Part A**

Please answer "Yes" or "No" for each of the following:

<p>| | | |</p>
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</table>
| ☐ Yes ☑ No | My company is authorized to transact business in Iowa.  
*(To help you determine if your company is authorized, please review the worksheet on the next page).* |
| ☐ Yes ☑ No | My company has an office to transact business in Iowa. |
| ☐ Yes ☑ No | My company’s office in Iowa is suitable for more than receiving mail, telephone calls, and e-mail. |
| ☐ Yes ☑ No | My company has been conducting business in Iowa for at least 3 years prior to the first request for bids on this project. |
| ☐ Yes ☑ No | My company is not a subsidiary of another business entity or my company is a subsidiary of another business entity that would qualify as a resident bidder in Iowa.  
If you answered "Yes" for each question above, your company qualifies as a resident bidder. Please complete Parts B and D of this form.  
If you answered "No" to one or more questions above, your company is a nonresident bidder. Please complete Parts C and D of this form. |

**Part B**

To be completed by resident bidders

My company has maintained offices in Iowa during the past 3 years at the following addresses:

<table>
<thead>
<tr>
<th>Dates:</th>
<th>Address:</th>
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</table>

You may attach additional sheet(s) if needed.

**Part C**

To be completed by non-resident bidders

1. Name of home state or foreign country reported to the Iowa Secretary of State:

2. Does your company’s home state or foreign country offer preferences to bidders who are residents? ☐ Yes ☑ No
3. If you answered “Yes” to question 2, identify each preference offered by your company’s home state or foreign country and the appropriate legal citation.

You may attach additional sheet(s) if needed.

**Part D**

To be completed by all bidders

I certify that the statements made on this document are true and complete to the best of my knowledge and I know that my failure to provide accurate and truthful information may be a reason to reject my bid.

Firm Name:  
Signature:  
Date:  

You must submit the completed form to the governmental body requesting bids per 875 Iowa Administrative Code Chapter 156.  
This form has been approved by the Iowa Labor Commissioner.
Worksheet: Authorization to Transact Business

This worksheet may be used to help complete Part A of the Resident Bidder Status form. If at least one of the following describes your business, you are authorized to transact business in Iowa.

☐ Yes ☐ No  My business is currently registered as a contractor with the Iowa Division of Labor.

☐ Yes ☐ No  My business is a sole proprietorship and I am an Iowa resident for Iowa income tax purposes.

☐ Yes ☐ No  My business is a general partnership or joint venture. More than 50 percent of the general partners or joint venture parties are residents of Iowa for Iowa income tax purposes.

☐ Yes ☐ No  My business is an active corporation with the Iowa Secretary of State and has paid all fees required by the Secretary of State, has filed its most recent biennial report, and has not filed articles of dissolution.

☐ Yes ☐ No  My business is a corporation whose articles of incorporation are filed in a state other than Iowa, the corporation has received a certificate of authority from the Iowa secretary of state, has filed its most recent biennial report with the secretary of state, and has neither received a certificate of withdrawal from the secretary of state nor had its authority revoked.

☐ Yes ☐ No  My business is a limited liability partnership which has filed a statement of qualification in this state and the statement has not been canceled.

☐ Yes ☐ No  My business is a limited liability partnership which has filed a statement of qualification in a state other than Iowa, has filed a statement of foreign qualification in Iowa and a statement of cancellation has not been filed.

☐ Yes ☐ No  My business is a limited partnership or limited liability limited partnership which has filed a certificate of limited partnership in this state, and has not filed a statement of termination.

☐ Yes ☐ No  My business is a limited partnership or a limited liability limited partnership whose certificate of limited partnership is filed in a state other than Iowa, the limited partnership or limited liability limited partnership has received notification from the Iowa secretary of state that the application for certificate of authority has been approved and no notice of cancellation has been filed by the limited partnership or the limited liability limited partnership.

☐ Yes ☐ No  My business is a limited liability company whose certificate of organization is filed in Iowa and has not filed a statement of termination.

☐ Yes ☐ No  My business is a limited liability company whose certificate of organization is filed in a state other than Iowa, has received a certificate of authority to transact business in Iowa and the certificate has not been revoked or canceled.
DOCUMENT 00 52 00

AGREEMENT FORMS

1. DOCUMENT INCLUDES

   A. Agreement.

2. RELATED DOCUMENTS

   A. Document 00 72 00 - General Conditions.
   B. Document 00 73 00 - Supplementary Conditions.

3. AGREEMENT

   A. AIA Document A101-2017, Standard Form of Agreement Between Owner and Contractor where basis of payment is a Stipulated Sum, forms the basis of Contract between the Owner and Contractor.

   B. AIA Document A101-2017 may be examined at the office of the Architect/Engineer during regular business hours.

END OF DOCUMENT
1. DOCUMENT INCLUDES
   A. Performance Bond.
   B. Payment Bond.
   C. Certificates of Insurance.

2. RELATED DOCUMENTS
   A. Document 00 73 00 - Supplementary Conditions.

3. PERFORMANCE BOND
   AIA Document A312-2010, Performance Bond and Payment Bond, forms the basis of Performance Bond between the Owner and Contractor.

   AIA Document A312-2010 may be examined at the office of the Architect/Engineer during regular business hours.

4. PAYMENT BOND
   AIA Document A312-2010, Performance Bond and Payment Bond, forms the basis of Payment Bond between the Owner and Contractor.

   AIA Document A312-2010 may be examined at the office of the Architect/Engineer during regular business hours.

3. CERTIFICATES OF INSURANCE
   Refer to Document 00 73 00 for Contractors liability insurance requirements.

END OF DOCUMENT
GENERAL CONDITIONS

1. DOCUMENT INCLUDES
   A. General Conditions.

2. RELATED DOCUMENTS
   A. Document 00 52 00 - Agreement Forms.
   B. Document 00 73 00 - Supplementary Conditions.

3. GENERAL CONDITIONS
   A. AIA Document A201-2017, General Conditions of the Contract for Construction, is the General Conditions between the Owner and Contractor.
   B. AIA Document A201-2017 may be examined at the office of the Architect/Engineer during regular business hours.

4. SUPPLEMENTARY CONDITIONS
   A. Refer to Document 00 73 00 for amendments to these General Conditions.

END OF DOCUMENT
1. SUMMARY

A. Document Includes:
   1. Supplementary Conditions.

B. Related Sections:
   1. Document 00 41 00 - Bid Forms.
   2. Document 00 52 00 - Agreement Forms.
   3. Document 00 72 00 - General Conditions.

2. INTRODUCTION

A. The following supplements modify AIA Document A201-2017, General Conditions of the Contract for Construction. Where a portion of the General Conditions is modified or deleted by these Supplementary Conditions, the unaltered portions of the General Conditions shall remain in effect.

ARTICLE 1 GENERAL PROVISIONS
§ 1.1 Basic Definitions

Delete last sentence of Section 1.1.1 and add the following:

The Contract Documents also include the bidding requirements (Notice to Bidders and Instructions to Bidders). Unless specifically enumerated in the Agreement, the Contract Documents do not include sample forms and the Contractor's Bid Form. The Contract Documents executed or identified in accordance with Subparagraph 1.5.1 shall prevail in case of an inconsistency with subsequent versions made through manipulatable electronic operations involving computers.

Add Section 1.1.2.1 as follows:

§ 1.1.2.1 The Contract Documents shall be signed by the Owner and Contractor. If either the Owner or Contractor or both do not sign all of the Contract Documents, the Architect/Engineer shall identify such unsigned Documents. No Contract shall be formed between the parties until all Contract Documents are executed by both parties.
Modify the second sentence in Section 1.1.8 to read as follows:

“The Initial Decision Maker shall not be liable for results of interpretations or decisions rendered in good faith.”

Add Section 1.1.9 to Section 1.1:

§ 1.1.9 Terms
The terms indicated below shall be defined as having the meanings assigned to them as follows:

.1 Products: Means new material, machinery, components, equipment, fixtures, and systems forming the Work, but does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components required for reuse.

.2 Furnish: To supply and deliver, unload, inspect for damage.

.3 Install: To unpack, assemble, erect, apply, place, finish, cure, protect, clean, and make ready for use.

.4 Provide: To furnish and install.

.5 Substitute the word ‘Architect/Engineer’ for ‘Architect’ each time the latter word appears.

§ 1.2 Correlation and Intent of the Contract Documents
Add the following sentence to the end of Section 1.2.1:

‘In the case of an inconsistency between Drawings and Specifications, or within either Document itself, not clarified by Addendum, the better quality or greater quantity of Work shall be provided in accordance with the Architect's interpretation. In any case of discrepancy, the facts are to be brought to the attention of the Architect for a decision or interpretation.’

Add Section 1.2.4 to Section 1.2:

§ 1.2.4 Sections of Division 1 - General Requirements govern the execution of the Work of all sections of the specifications.
§ 1.4 Interpretation
Add Section 1.4.2 to Section 1.4

§ 1.4.2 In the event of conflicts or discrepancies among the Contract Documents not clarified by Addendum, interpretations will be based on the following priorities:
.1 Modifications to Contract.
.2 The Agreement.
.3 The Supplementary Conditions.
.4 The General Conditions of the Contract for Construction.

§ 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service
Delete Section 1.5.1 and substitute the following:

§ 1.5.1 Provided all payments have been made that are due to Architect/Engineer in accordance with its agreement with Owner, Design Documents or other Instruments of Service are Owner’s exclusive property. Owner retains all common law, statutory and other reserved rights in the Design Documents or other Instruments of Service, including all copyrights in and to Design Documents and other Instruments of Service. Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers shall not own or claim copyright in Design Documents or other Instruments of Service. Submittal or distribution to meet official regulatory requirements, or for other purposes in connection with Project are not to be construed as publication in derogation of Owner’s reserved rights.

§ 1.7 Digital Data Use and Transmission
Delete Section 1.7 text and add Sections 1.7.1 and 1.7.2:

§ 1.7.1 The Architect/Engineer may, with the concurrence of the Owner, furnish to the Contractor versions of Instruments of Service in electronic form. The Contract Documents executed or identified in accordance with Subparagraph 1.5.1 shall prevail in case of an inconsistency with subsequent versions made through manipulatable electronic operations involving computers.

§ 1.7.2 At Contractor’s written request, copies of Architect/Engineer’s CAD files may be provided to Contractor for Contractor’s exclusive use in connection with Project, subject to the following conditions:
.1 Electronic copies of plan-type Drawings will be made available at cost of $100 for each requested Drawing. Electronic copies will be distributed upon receipt of service fee.
.2 Contractor making request shall not distribute files to other parties.
.3 Contractor making request shall sign copy of CAD/Electronic File Transfer request form and return to Architect/Engineer prior to receipt of CAD/Electronic files. Architect/Engineer will provide form for Contractor’s signature. Sample copy of form is included in Appendix A.

.4 Electronic copies of Consultant’s plan-type Drawings will be made available at the discretion of each Consultant. Contractor shall be responsible for contacting individual Consultant, and abide by any fee and file transfer form requirements they impose.

ARTICLE 2 OWNER

Delete Section 2.1.2.

§ 2.2 Evidence of the Owner’s Financial Arrangements

Delete entire Section 2.2.

§ 2.3 Information and Services Required of the Owner

Modify Section 2.3.3 to read as follows:

‘If the employment of the Architect terminates, the Owner shall employ a successor whose status under the Contract Documents shall be that of the Architect.’

Add the following at end of Section 2.3.4:

‘The Contractor shall compare information furnished by the Owner (including surveys and soils tests with observable physical conditions) and the Contract Documents, and on the basis of such review, shall report to the Owner and Architect/Engineer any conflicts, errors or omissions. Contractor shall be responsible for any additional costs, delays, and damages resulting from the Contractor’s failure to immediately report any such errors, inconsistencies or omissions it discovers.’

Delete Section 2.3.6 and substitute the following:

§ 2.3.6 The Owner will furnish the Contractor, free of charge, as many copies of Contract Documents as can be allocated for this use from quantities returned by Bidders. Contractor may purchase additional copies at the cost of reproduction, postage, and handling.
Add Section 2.3.7 to Section 2.3:

§ 2.3.7 Unless otherwise specified in the Contract, the Owner will procure and bear costs of structural tests and special inspections as required by the applicable building code.

§ 2.5 Owner’s Right to Carry Out the Work

Delete Section 2.5 text and substitute the following:

‘If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents, and fails within a 7 day period, or such shorter time period as may be reasonable under circumstances, after receipt of written notice from the Owner to the Contractor, to commence and continue correction of such default or neglect with diligence and promptness, the Owner may notify the Surety and request it to assume the obligations of the Contractor within 7 days following receipt by Contractor and Surety of written notice or the Owner may, without prejudice to any other remedies the Owner may have, correct such deficiencies. In such case an appropriate Change Order or Construction Change Directive shall be issued deducting from the payments then or thereafter due the Contractor, the cost of correction of such deficiencies, including reasonable attorney’s fees and compensation for the Architect/Engineer’s additional services incurred as result of such default, neglect or failure. Such action by Owner, and amounts charged to the Contractor are both subject to prior concurrence with Architect/Engineer. If current or future payments thereafter due Contractor are not sufficient to cover such amounts, Contractor, or Surety, shall pay difference to Owner.’

ARTICLE 3 CONTRACTOR
§ 3.1 General

Add the following at end of Section 3.1.1:

‘Contractor shall at request of Owner prior to execution of Agreement and promptly from time to time as requested by the Owner, thereafter furnish Owner an update and current financial statement and/or Contractor Qualification Statement on AIA Document A305.’

Add Section 3.1.2.1 as follows:

§ 3.1.2.1 The Contractor shall supervise and direct Work in excellent and workmanlike manner, complete the work and everything properly incidental thereto as stated in the Project Manual and Drawings or reasonably implied therefrom and otherwise in accordance with Contract Documents. In no case shall the Contractor proceed with any portion of the Work in any uncertainty.
Add the following at the end of Section 3.1.3:

§ 3.1.3 The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect’s administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor. To the extent permitted by law, the Contractor waives any rights, claims, or causes of action against Owner as a result of activities or duties or intentional or negligent misconduct by the Architect in the Architect’s administration of the Contract, or representations made by Architect/Engineer in Instruments of Service.

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

Add the following at end of Section 3.2.1:

‘The Contractor also represents that all Contract Documents for the Project have been examined; including those intended for work of trades not normally performed by Contractor’s own forces, and that they have become thoroughly familiar with all conditions which may pertain to, or affect Work under the Contract.’

Modify Section 3.2.2 to add the words:

‘including any ordering of materials’ in line 2 after the word “Work.”

Delete Sections 3.2.3 and 3.2.4 and substitute the following:

§ 3.2.3 Contractor shall take field measurements and verify Site conditions, and shall carefully compare such field measurements and Site conditions and other information know to Contractor with Contract Documents, before ordering any material or doing any Work at Site.

§ 3.2.4 Contractor shall make frequent inspections during progress of Work to confirm that Work previously performed by Contractor is in compliance with Contract Documents and applicable laws and regulations bearing on performance of Work and Referenced Standards and that portion of Work previously performed by Contractor or by others are in proper condition to receive subsequent Work.
Add Sections 3.2.5 thru 3.2.8 to Section 3.2:

§ 3.2.5 If Contractor believes that any portion of Contract Documents do not comply with applicable laws, statutes, ordinances, building codes, and rules and regulations, or any orders by code enforcement officials or Owner or its designees acting in capacity of building code inspectors or Referenced Standards, Contractor shall promptly notify Owner and Architect/Engineer of non-compliance as provided in Section 3.2.6 and request direction before proceeding with affected Work.

§ 3.2.6 Contractor shall promptly notify Owner and Architect/Engineer in writing of any apparent errors, inconsistencies, omission, ambiguities, construction impracticalities or code violations discovered as result of Contractor’s review of Contract Documents including any differences between actual and indicated dimensions, locations and descriptions, and shall give Owner and Architect/Engineer timely notice in writing of same and any corrections, clarifications, additional Drawings or Specifications, or other information required to define Work in greater detail or to permit proper progress of Work. Contractor shall provide similar notice with respect to any variance between its review of Site and physical data and Site conditions observed.

§ 3.2.7 If Contractor performs any Work involving an apparent error, inconsistency, ambiguity, construction impracticality, omission or code violation in Contact Documents of which Contractor is aware, or which could reasonably have been discovered by review required by Section 3.2, without promptly written notice to Owner and Architect/Engineer and request for correction, clarification or additional information, as appropriate, Contractor does so at its own risk and expense and all claims relating thereafter are specifically waived.

§ 3.2.8 The Owner is entitled to reimbursement from the Contractor for amounts paid to the Architect/Engineer for evaluating and responding to the Contractor’s requests for information that are not prepared in accordance with the Contract Documents or where the requested information is available to the Contractor from a careful study and comparison of the Contract Documents, field conditions, or other Owner-provided information, Contractor-prepared coordination drawings, or prior Project correspondence or documentation.

§ 3.3 Supervision and Construction Procedures

Modify Section 3.3.1 to add the word “written” between the words “timely” and “notice” in line 7.
Add Section 3.3.4 as follows:

§ 3.3.4 The Contractor acknowledges that it is Contractor's responsibility to hire all personnel for the proper and diligent prosecution of the Work and the Contractor shall use its best efforts to maintain labor peace for the duration of the Project. In the event of a labor dispute, the Contractor shall not be entitled to any increase in the Contract Sum.

§ 3.4 Labor and Materials

Add the following at end of Section 3.4.1:

'Work required by the Contract Documents to be performed after working hours, or work the Contractor elects to perform after hours shall be completed at no additional cost to the Owner.'

Add Sections 3.4.2, 3.4.2.1, 3.4.2.2 and 3.4.2.3 to Section 3.4.2:

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

§ 3.4.2.1 After the Contract has been executed, the Architect, Owner, and Contractor shall function as a team to evaluate, review and consider substitution of products in place of those specified under the conditions set forth by the Architect.

§ 3.4.2.2 After the Contract has been executed, the Owner and Architect/Engineer may consider requests for the substitution of products in place of those specified. The Owner and Architect/Engineer may, but are not obligated to, consider only those substitution requests that are in full compliance with the conditions set forth in the General Requirements (Division 1 of the Specifications). By making requests for substitutions, the Contractor:

.1 represents that it has personally investigated the proposed substitute product and determined that it is equal or superior in all respects to that specified;

.2 represents that it will provide the same warranty for the substitution as it would have provided for the product specified;

.3 certifies that the cost data presented is complete and includes all related costs for the substituted product and for Work that must be changed as a result of the substitution, except for the Architect/Engineer's redesign costs, and waives all claims for additional costs related to the substitution that subsequently become apparent; and
Agrees that it shall, if the substitution is approved, coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects.

§ 3.4.2.3 The Owner shall be entitled to reimbursement from the Contractor for amounts paid to the Architect/Engineer for reviewing the Contractor’s proposed substitutions and making agreed-upon changes in the Drawings and Specifications resulting from such substitutions.

Add the following to the end of Section 3.4.3:

Persons permitted to perform Work under Contractor or any Subcontractor or Sub-Subcontractor shall meet all employment eligibility, safety training, security or drug/alcohol testing requirements required by law or by Owner. Any person not complying with all such requirements shall be immediately removed from the site.

Add Section 3.4.3.1 to Section 3.4.3:

§ 3.4.3.1 The Contractor or its Subcontractors (“Company”) shall not be owned, operated, or managed by a registered sex offender who has been convicted of a sex offense against a minor in accordance with Iowa Code 692A.113. In addition, the Contractor or their Subcontractors shall not permit an employee who is a registered sex offender convicted of a sex offense against a minor on real property of the schools of the Owner (“District”) in accordance with Iowa Code 692A.113. The Contractor and its Subcontractors shall further acknowledge and certify services provided under this Contract comply with Iowa Code 692A.113, and shall fully execute and deliver copies of Appendix B - Acknowledgment and Certification to the District prior to execution of Agreement.

§ 3.5 Warranty

Delete Section 3.5.1 and add Sections 3.5.1 through 3.5.5:

3.5.1 Contractor shall warrant to Owner that materials and equipment furnished under Contract will be of good quality and new unless otherwise required or permitted by Contract Documents, that workmanship will be free from defects not inherent in quality required or permitted, that workmanship will comply with all applicable laws, building codes, rules and regulations, and that workmanship will conform to requirements of Contract Documents.
§ 3.5.2 Contractor's general warranty and any additional or special warranties shall not be limited by Contractor's obligations to specifically correct defective or nonconforming Work as provided in Article 12, nor shall they be limited by any other remedies provided in Contract Documents. Contractor shall also be liable for any damage to property or persons (including death) including consequential and direct damages relating to any breach of Contractor's general warranty or any additional or special warranties required by Contract Documents.

§ 3.5.3 Contractor shall furnish all special warranties required by Contract Documents to Owner no later than Substantial Completion. Owner may require additional special warranties in connection with approval of ‘Or-Equals’ or Substitutions, Allowance items, Work that is defective or nonconforming, or acceptance of nonconforming Work pursuant to Article 12.

§ 3.5.4 In case of Work performed by Subcontractors and where warranties are required, secure warranties from said Subcontractors addressed to and in favor of Owner. Deliver copies of same to Architect/Engineer upon completion of Work. Delivery of said warranties shall not relieve Contractor from any obligations assumed under any other provision of Contract.

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

§ 3.6 Taxes

Delete Section 3.6 text and add Sections 3.6.1 through 3.6.7 to Section 3.6:

§ 3.6.1 Iowa Use Taxes shall be paid on all supplies and materials used in, and made component parts of, the Project.

§ 3.6.2 Iowa Sales Taxes shall not be paid on qualified building materials purchased, or withdrawn from inventory, which will be incorporated into real property for Project.

§ 3.6.3 The Owner is a designated exempt entity and will complete an online application to register this Contract with the Iowa Department of Revenue and Finance. The Owner will distribute Tax Exemption Certificates and Authorization Letters to the Contractor and all Subcontractors who have been identified at, or before filing of the Performance Bond. Refer to Iowa Department of Revenue and Finance publications available at http://www.state.ia.us/tax/business/Contr-ExEnt-Index.html.
§ 3.6.4 At or before the time the Performance Bond is filed, Contractor shall provide a listing to the Owner identifying all Subcontractors. Listing shall indicate company name, address, telephone number, fax number, contact name, and Employer ID # for Contractor and each Subcontractor. Contractor and Subcontractors shall make copies of the Tax Exemption Certificate and provide to each supplier providing construction material, a copy of the Tax Exemption Certificate. This Certificate will allow the Contractor and Subcontractors to purchase qualified building materials free from sales tax for the Project. The Tax Exemption Certificate and Authorization Letter have been developed exclusively for this purpose and are applicable only for the specific Project under this Contract.

§ 3.6.5 Payment will be made in accordance with the payment provisions set out in these specifications and in the Notice to Bidders and Notice of Public Hearing. Notwithstanding anything in these specifications and the Notice to Bidders and Notice of Public Hearing to the contrary, no Final Payment shall be released until Form 35-002 has been filed with the Owner, where applicable, and all lien waivers and 573 claims releases are on file.

§ 3.6.6 Contractor shall be responsible for informing themselves of tax laws, requirements, regulations, and interpretations as they apply to this Project.

§ 3.6.7 Contractor shall maintain all records, invoices, receipts, or other accounting data regarding material purchases and shall allow, upon written request of Owner, and within reasonable time frame after receipt of such request, Owner to audit such records to verify tax savings. If audit reveals taxes paid or savings not transferred to Owner, Contractor shall be liable to Owner for those amounts and Owner may back charge Contractor for those amounts if balance of funds due and payable remains at time of such discovery.

.1 Contractor shall require all Subcontractors of any tier to maintain all records, invoices, receipts, or other account data regarding material purchases. Contractor shall collect such records with each application for payment if receives from its Subcontractors and shall maintain such records in same manner and location as Contractor’s records.

.2 Contractor shall ensure its Subcontractors and any lower-tier Subcontractors including these obligations in their contracts and bind themselves in same manner as Contractor is bound to Owner.
§ 3.7 Permits, Fees, Notices, and Compliance with Laws

Delete Section 3.7.1 and substitute the following:

§ 3.7.1 Unless otherwise specified in the Contract Documents, the Contractor shall secure and pay for the building permit and other permits and governmental fees, licenses, and inspections necessary for proper execution and completion of the Work which are legally required when bids are received or negotiations concluded.

Delete Section 3.7.3 and substitute the following:

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

Add Sections 3.7.6 through 3.7.8 to Section 3.7:

§ 3.7.6 The Contractor shall be responsible for scheduling inspections related to performance of their Work, and shall ensure Work is complete and ready for inspections. Any costs associated with reinspection caused by irregularities, deficiencies or non-conforming Work will be borne by Contractor, including all architectural and engineering services related to evaluation of problems and development of any acceptable solutions.

§ 3.7.7 The Contractor shall take note and comply with all governing laws, rules, and regulations affecting the Work. This may include, but is not limited to, such laws, rules, and regulations as:

.1 Licensing of Contractors for special requirements, eg hazardous waste removal.
.2 Requirements for special construction permits.
.3 Exemption from sales tax, if applicable.
.4 Wage rates and employment requirements when required by law or by Owner.
.5 Local labor requirements.
.6 Non-discriminatory hiring practices.

§ 3.7.8 State of Iowa, its agencies, and its political subdivisions, including cities, school districts and public utilities are required by Iowa Code 73A.21 to require reciprocal resident bidder and resident labor force preference.
§ 3.7.8.1 ‘Resident Bidder’ means person or entity authorized to transact business in State of Iowa and having place of business for transacting business with state at which it is conducting and has conducted business for at least 3 years prior to date of first advertisement for public improvement. If another state or foreign country has more stringent definition of Resident Bidder, more stringent definition shall be applicable as to bidders from that state or foreign country.

§ 3.7.8.2 Resident Bidder shall be allowed preference against nonresident bidder from state or foreign country other than Iowa if that state or foreign country gives or requires any preference to bidders from that state or foreign country, including, but not limited to, any preference to bidders, the imposition of any type of force preference, or any other form of preferential treatment to bidders or laborers from state or foreign country. Preference allowed shall be equal to preference given or required by state of foreign country in which nonresident bidder is resident.

§ 3.7.8.3 If Contractor is nonresident bidder Contractor is required to specify in Agreement between Owner and Contractor, whether any preference is in effect in nonresident bidder's state or country at time of this bid and identify source of regulations.

§ 3.9 Superintendent

Add the following to the end of the first sentence of Section 3.9.1:

', including Work of the Contractor's subcontractors. Any change in superintendent personnel must be approved by the Owner.'

Delete Subparagraph 3.9.2 and substitute the following:

§ 3.9.2 The Contractor shall, within 2 days of the Owner's notification of an intent to award the Contract, submit to the Owner, through the Architect/Engineer, the name and qualifications of the proposed superintendents for review and approval. When the superintendents are approved, they shall not be removed without the Owner's written approval which will not be unreasonable withheld. The responsibility of the superintendent is to supervise, schedule, coordinate, and manage field operations.
§ 3.10 Contractor’s Construction and Submittal Schedules

Delete Sections 3.10.1 and 3.10.2 and substitute the following:

§ 3.10.1 The Contractor, within ten days of award of Contract, shall prepare and submit in its native electronic and graphic format, Owner's and Architect/Engineer's approval Contractor's baseline construction schedule for Work. Schedule shall not exceed time limits current under Contract Documents, shall be revised at appropriate intervals as required by conditions of Work and Project, shall be related to entire Project to extent required by Contract Documents, or as requested by Owner or Architect/Engineer, and shall provide for expeditious and practicable execution of Work.

Schedule at minimum shall demonstrate rate of work (ROW), availability dates, permits, submittals, working drawings, procurement, fabrication, delivery of materials, construction, and other activities necessary to complete Work.

Thereafter, Contractor shall prepared and update construction schedule on at least a monthly basis (“Current Construction Schedule”), if not more frequently at Owner’s or Architect’s request, to be submitted to Owner in graphic and native electronic format with each Application for Payment. Each update shall include narrative including:

.1 Description of status of schedule.
.2 Discussion of current and anticipated delays.
.3 Discussion of progress of critical path activities.
.4 Discussion of critical path for remainder of project.
.5 Listing and discussion of logic changes and duration changes.

§ 3.10.2 Contractor shall prepare submittal schedule within fourteen days after being awarded Contract and thereafter as necessary to maintain current submittal schedule, and shall submit schedule(s) for Architect/Engineer's approval. Architect/Engineer's approval shall not unreasonably be delayed or withheld. Submittal schedule shall:

.1 be coordinated with Contractor's construction schedule, and;
.2 allow Architect/Engineer reasonable time to review submittals.

If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.
Add Section 3.10.4 as follows:

§ 3.10.4 The Contractor shall furnish information concerning the Work. This information will include, but not be limited to the following:
   Daily: Manpower by craft.
   Weekly: Two week look ahead schedule update. Delivery requirements and status of materials.
   Monthly: Written report including schedule update as outlined above and cost information.

§ 3.11 Documents and Samples of Site

Delete Section 3.11 text and substitute the following:

Contractor shall maintain at site for Owner one copy of Drawings, Specifications, Addenda, Current Construction Schedule, Change Orders and other Modifications, in good order and marked currently to indicate field and similar required submittals. Contractor shall display current Construction Schedule at site for reference and reliance by Owner and Architect/Engineer. These shall be available to Architect/Engineer and shall be delivered to Architect/Engineer for submittal to Owner upon completion of Work as record of Work as constructed.

§ 3.12 Shop Drawings, Product Data and Samples

Add the following at end of Section 3.12.5:

‘Contractor shall provide Owner and Architect/Engineer with copies of all submittals made to regulatory agencies.’

Add the following at end of Section 3.12.7:

‘Contractor shall correct at their cost, and without any adjustment in Contract time, any Work the correction of which is required due to Contractor's failure to obtain approval of submittal required to have been obtained prior to proceeding with Work, including, but not limited to, correction of any conflicts in Work resulting from such failure.’

Modify Section 3.12.10.1 by adding the word “reasonably” before the word “rely” in line 4.
Add Section 3.12.11 to Section 3.12:

§ 3.12.11 The Architect/Engineer’s and Consultant’s review of Contractor’s submittals will be limited to examination of an initial submittal and 1 resubmittal. Architect will notify the Contractor before beginning a further review that such review will result in additional cost to the Owner which can be charged back to Contractor. The Contractor shall reimburse the Owner for amounts paid to the Architect/Engineer for evaluation of additional resubmittals.

§ 3.13 Use of Site

Add Sections 3.13.1, 3.13.2, and 3.13.3 to Section 3.13:

§ 3.13.1 Except as may be specifically provided in Contract Documents, Contractor shall provide all necessary temporary facilities, including power, water, sanitation, scaffolding, storage, and security. If Owner makes any such facilities available to Contractor, it is without representation or warranty as to their adequacy for Contractor’s use, and Contractor shall indemnify, defend, and hold Owner harmless from and against any claims arising out of Contractor’s use of such facilities.

§ 3.13.2 Contractor shall perform Work so as to cause minimum of inconvenience to and interruption of Owner’s operations. Any and all interruptions of operations of Owner necessary for performance of Work shall be noted in progress schedule and Contractor shall additionally give Owner sufficient advance notice of such interruption as to allow Owner to adjust operations accordingly. Contractor’s failure to give Owner timely notice of such intentions shall place responsibility of any resulting delays or additional costs solely on Contractor.

§ 3.13.3 Contractor shall not bring or permit any subcontractor, supplier or anyone else for whom Contractor is responsible, to bring on site any asbestos, PCB's, petroleum, hazardous waste, or radioactive materials (except for proper use in performing Work).

§ 3.15 Cleaning Up

Delete Section 3.15 title above and substitute the following:
§ 3.15 Cleaning Up, Working Hours, and Noise Ordinance

Delete Sections 3.15.1 and 3.15.2 and substitute the following

§ 3.15.1 Work shall be performed in accordance with Contract Documents, Applicable Building Codes, and other applicable law governing Contractor's performance of Work. No delays resulting from compliance with applicable laws or regulations may form basis for any claim by Contractor for delay damages or additional compensation or for any extensions of Contract Time. Contractor shall not permit work outside of hours established in Contract Documents on Saturday, Sunday or State or federal holiday without written consent of Owner, given after prior written notice to Architect/Engineer and any other applicable consultants; such consent, if given, may be conditioned upon payment by Contractor of Owner's, Architect/Engineer's and any other applicable consultants' additional costs and fees, testing or regulatory agency costs incurred in monitoring such off-hours Work. Contractor shall notify Owner as soon as possible if Work must be performed outside of such times in interest of safety and protection of persons or property at Site or adjacent thereto, or in event of emergency. In no event shall Contractor permit Work to be performed at Site without presence of Contractor's superintendent and person responsible for protection of persons and property at Site and compliance with all applicable laws and regulations, if different from superintendent.

§ 3.15.2 Contractor shall comply with any applicable Noise Ordinances and any successor or substitute provisions covering regulation of noise levels. It shall be the duty of Contractor to familiarize themselves with those provisions and perform Work in compliance with those provisions.

Add Section 3.15.3 to Section 3.15:

§ 3.15.3 Contractor shall keep Site and adjacent areas free from accumulation of waste materials or rubbish caused by operations under Contract, and shall keep tools, construction equipment, machinery and surplus materials suitably stored when not in use. If Contractor fails to do so in manner reasonably satisfactory to Owner or Architect/Engineer within 48 hours after notice or as otherwise required by Contract Documents, Owner may clean Site and back charge Contractor for all costs associated with cleaning. Contractor shall keep premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under Contract. At completion of Work, Contractor shall remove waste materials, rubbish, Contractor's tools, construction equipment, machinery and surplus materials from and about Project.
§ 3.18 Indemnification

Delete Section 3.18.1 and substitute the following:

§ 3.18.1 To the fullest extent permitted by law, the Contractor shall defend, indemnify, and hold harmless Owner, its agents, representatives, and employees (“Indemnitees”) from and against all claims, damages, losses and expenses, including, but not limited to, attorney’s fees, arising out of or resulting from or in connection with performance of the Work, but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or otherwise reduce any other right or obligation of indemnity or contribution which would otherwise exist, as to any party or person described in Contract Documents.

Add Section 3.18.3 to Section 3.18:

§ 3.18.3 If a suit, action, arbitration or other legal proceeding is instituted in connection with any controversy arising out of this Agreement or to interpret or enforce any rights under this Agreement, the Owner shall be entitled to recover from the non-prevailing party all attorney fees, costs, expert witness fees, and expenses incurred by the Owner during pre-suit collection attempts, suit and post judgment or settlement collection, including those incurred on appeal.

ARTICLE 4 ARCHITECT

§ 4.2 Administration of the Contract

Delete Section 4.2.2 and substitute the following:

§ 4.2.2 The Architect, as a representative of the Owner, shall attend all construction meetings and visit the site while Work is in progress not less than monthly, or as otherwise mutually agreed to by the parties, to observe and evaluate the site and the Work; to become familiar with the progress and quality of the Work; and to determine whether the Work evaluated and observed is proceeding in accordance with the Contract Documents and construction schedule and whether there are defects or deficiencies in the Work evaluated and observed.
Add Section 4.2.2.1 to Section 4.2.1:

§ 4.2.2.1 The Owner is entitled to reimbursement from the Contractor for amounts paid to the Architect/Engineer for site visits made necessary by the fault of the Contractor or by defects and deficiencies of the Work.

Delete Section 4.2.3 and substitute the following:

§ 4.2.3 On the basis of on-site observations and evaluations, the Architect shall keep the Owner reasonably informed of the progress and quality of the Work and its conformance with the Contract Documents and the construction schedule. The Architect will provide the Owner with a monthly observation report and construction update minutes as the Project progresses. The Architect shall report to the Owner (1) known deviations from the Contract Documents and from the most recent construction schedule submitted by the Contractor and (2) defects and deficiencies observed in the Work. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for, the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor’s rights and responsibilities under the Contract Documents, except as provided in Section 3.3.1.

Delete Section 4.2.4 and substitute the following:

§ 4.2.4 Communications
Except as otherwise provided in the Contract Documents or when direct communications have been specially authorized, the Owner and Contractor shall include the Architect in communications that relate to or affect the Architect’s services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any relevant direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect’s consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

Add Section 4.2.7.1 to Section 4.2.7:

§ 4.2.7.1 In no case will the Architect/Engineer's review period on any submittal be less than fifteen days after receipt of the submittal from the Contractor.
Add Section 4.2.14.1 to Section 4.2.14:

§ 4.2.14.1 Contractor’s requests for information shall be prepared and submitted in accordance with Division 1 “General Requirements” sections on form acceptable to Architect/Engineer. The Architect/Engineer will return without action requests for information that does not conform to requirements of the Contract Documents.

ARTICLE 5 SUBCONTRACTORS

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

In the 2\textsuperscript{nd} line of Section 5.2.1, after the word ‘Contractor’, delete the phrase ‘as soon as practicable after award of the Contract’, and insert the phrase ‘within ten days after the date of the notice of award of the Contract’.

Add the following to the end of Section 5.2.1:

'A list of Subcontractors shall be submitted in duplicate on AIA Document G805, 2001 Edition. Contractor shall update this list throughout Project and keep Owner and Architect/Engineer advised of any new subcontractors employed.'

Add Section 5.2.5 to Section 5.2:

§ 5.2.5 Manufacturers and Fabricators

§ 5.2.5.1 Not later than 30 days after the date of commencement of the Work, the Contractor shall furnish in writing to the Owner through the Architect/Engineer the names of persons or entities proposed as manufacturers or fabricators for certain products, equipment and systems identified in the General Requirements (Division 1 of the Specifications) and, where applicable the name of the installing Subcontractor. The Architect/Engineer may reply within 14 days to the Contractor in writing stating:

\begin{itemize}
  \item [.1] whether the Owner or the Architect/Engineer has reasonable objection to any such proposed person or entity, or
  \item [.2] that the Architect/Engineer requires additional time to review.
\end{itemize}

Failure of the Owner or Architect/Engineer to reply within the fourteen-day period shall constitute notice of no reasonable objection.

§ 5.2.5.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect/Engineer has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.
§ 5.2.5.3 If the Owner or Architect/Engineer has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect/Engineer has no reasonable objection. If the proposed but rejected manufacturer or fabricator was reasonable capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute manufacturer's or fabricator's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.5.4 The Contractor shall not substitute a person or entity previously selected if the Owner or Architect/Engineer makes reasonable objection to such substitution.

§ 5.4 Contingent Assignment of Subcontracts

Delete Section 5.4.2 in its entirety.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 Owner’s Right to Perform Construction and to Award Separate Contractors

Add the following to the end of Section 6.1.1

The Contractor shall give notification of the potential of a claim in writing to the Owner and/or Separate Contractor within forty-eight (48) hours of the occurrence or discovery of the potential of an occurrence of the delay or action that will result in making a claim.

§ 6.2.2 Delete the last sentence of Section 6.2.2 and insert the following to the end of section:

', except as to defects not then reasonably discoverable.'

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

Add the following at end of Section 7.1.1:

'No claim for an addition to the maximum Contract sum shall be considered a valid claim unless a written change order procedure is followed as outlined in this Section. Verbal authorization for changes must be supported by written approval before being considered valid.'
Add Section 7.1.4 to Section 7.1:

§ 7.1.4 The combined overhead and profit included in the total cost to the Owner for a change in the Work, whether by Change Order or Construction Change Directive shall be based on the following schedule:

.1 10% if Work is performed by the Contractor, 5% if Work is performed by Subcontractor or Sub-subcontractor.

.2 5% if Work is performed by Subcontractor or Sub-subcontractor. Subcontractor and Sub-subcontractor’s total aggregate shall not exceed 10% percent.

.3 Cost to which overhead and profit is to be applied shall be determined in accordance with Section 7.3.7.

.4 On Work deleted from the Contract, credit to the Owner shall be the Architect/Engineer approved net cost plus 1/2 of the overhead and profit percentage noted above.

.5 In order to facilitate checking of quotations for extras or credits, all proposals, except those so minor that their propriety can be seen by inspection, shall be accompanied by a complete itemization of costs including labor, materials and Subcontracts. Labor and materials shall be itemized in the manner described above. Where major cost items are Subcontracts, they shall be itemized also. In no case will a change involving over $500.00 be approved without such itemization.

§ 7.2 Change Orders

Add Section 7.2.2 to Section 7.2:

§ 7.2.2 Contractor shall submit change proposals covering contemplated Change Order within 10 days after request of Owner, or Architect/Engineer or within 10 days after event giving rise to Contractor’s claim for change in Contract Sum or Contract Time. No increase in Contract Sum or extension of Contract Time will be allowed Contractor for cost or time involved in making change proposals. Change proposals shall define or confirm in detail Work which is proposed to be added, deleted, or changes and shall include any adjustment which Contractor believes to be necessary in (i) Contract Sum, (ii) Contract time. Any proposed adjustment shall include detailed documentation including, but not limited to; cost, properly itemized and supported by sufficient substantiating data to permit evaluation including cost of labor, materials, supplies and equipment, rental cost of machinery and equipment, additional bond cost, plus fixed fee for profit and overhead (which includes office overhead and site-specific overhead and general conditions) of 10% if Work is performed by Contractor, or 5% if Work is performed by Subcontractor or Sub-subcontractor. Subcontractors and Sub-subcontractors overhead and profit in turn shall not exceed total aggregate of 10%.
Change proposals shall be binding upon Contractor and may be accepted or rejected by Owner at their discretion. Owner may, at their option, instruct Contractor to proceed with Work involved in change proposal in accordance with this section without accepting change proposal in its entirety.

Add Sections 7.2.3 and 7.2.4 to Section 7.2 as follows:

§ 7.2.3 If the Owner determines that a change proposal is appropriate, the Architect will prepare and submit a request for a Change Order or Contract Amendment providing for an appropriate adjustment in the Contract Sum or Contract Time, or both, for further action by the Owner. No such change is effective until the Owner and Architect sign the Change Order.

§ 7.2.4 The forms used to process a Change Order will include AIA Document, G701 Change Order.

§ 7.3 Construction Change Directives

Add the following at end of Section 7.3.2:

`; upon prior written approval from Owner`.

ARTICLE 8 TIME

§ 8.1 Definitions

Add the following at end of Section 8.1.2:

‘; or the date of the Notice to Proceed, whichever occurs later’.

§ 8.2 Progress and Completion

Capitalize the word Site in the 2nd line of Section 8.2.2.

Add the following at end of 1st sentence of Section 8.2.2:

‘, or prior to approval of Certificates of Insurance, and Additional Insured Endorsement and Notice of Cancellation Endorsement required to be submitted to Owner under Contract’.

Add the following at end of Section 8.2.3:

‘If Contractor's Work shall fall behind schedule for reasons that are not excused under terms of Contract, Contractor shall add additional workers or shifts, and/or work overtime as necessary to maintain Construction Schedule’.
Add Section 8.2.4 through 8.2.8 to Section 8.2’.

§ 8.2.4 Contractor shall conform to most recent approved Construction Schedule. Contractor shall complete indicated Work or achieve required percentage of completion, as applicable, within any interim completion dates established in most recently approved Construction Schedule.

§ 8.2.5 Contractor shall maintain at Site, available to Owner and Architect/Engineer for their reference during progress of Work, a copy of approved Construction Schedule and any approved revisions thereto. Contractor shall keep current records of, and mark on copy of approved Construction Schedule actual commence date, progress, and completion date of each scheduled activity, indicated on Construction Schedule.

§ 8.2.6 Contractor represents that their Bid includes all costs, overhead and profit which may be incurred throughout Contract Time and period between Substantial and Final Completion. Accordingly, Contractor shall not make any claim for delay damages based in whole or in part on premise that Contractor would have completed Work prior to expiration of Contract time but for any claimed delay.

§ 8.2.7 If Contractor's progress is not maintained in accordance with approved Construction Schedule, or the Owner determines that Contractor is not diligently proceeding with Work or has evidence reasonably indicating that Contractor will not be able to conform to most recently approved Construction Schedule, Contractor shall, promptly and at no additional cost to Owner, take all measures necessary to accelerate its progress to overcome delay and ensure that there will be no further delay in progress of Work and notify Owner.

§ 8.2.8 Owner reserves right to issue written directive to accelerate Work that may be subject to an appropriate adjustment, if any, in Contract Sum. If Owner requires an acceleration of Construction Schedule and no adjustments are made in Contract Sum, or if Contractor disagrees with any adjustment made, Contractor shall file claim a provided in Article 15 or same will be deemed to be conclusively waived.

§ 8.3 Delays and Extensions of Tim

Delete the words "labor dispute" and add the words 'excusable weather delays as defined in Section 15.1.5.2,' between the words ‘fire’ and ‘unusual’ in 3rd line of section 8.3.1.
Add the following at end of Section 8.3.1:

'A time extension shall be Contractor's only remedy and compensation for all such delays other than those resulting from the acts of negligence of the Owner, the Architect/Engineer, or the Owner's separate contractors (collectively “Owner Caused Delays”). For proven Owner Caused Delays, the Contractor may recoup the actual costs resulting from such delays, but not for any additional profit or fee.'

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.2 Schedule of Values

In the 1st sentence, add the words ‘thirty (30) days’ between the words ‘Architect,’ and ‘before’.

§ 9.3 Applications for Payment

Delete Section 9.3.1 and substitute the following:

§ 9.3.1 At least 30 days before the date established for each progress payment, Contractor shall submit to Architect/Engineer an itemized Application for Payment for operations completed in accordance with Schedule of Values. Such application shall be notarized, supported by such data substantiating Contractor's right to payment as Owner or Architect/Engineer may require, such as copies of requisitions and release of claims from Subcontractors and suppliers. If the Contract Documents require Owner to retain a portion of payments until some future time, Applications for Payment shall clearly state percentage and amount to be retained.

Once Application is approved by Architect/Engineer, Application for Payment will be submitted to Owner for its approval at its next regularly scheduled meeting. The Application must be received at the Owner’s office in accordance with Owner’s outlined procedures as applicable. Unless notified otherwise, the Application shall be received by Owner at least one week prior to scheduled meeting for it to be included in that meetings scheduled business.


Modify Section 9.3.1.2 by inserting the following the word “Payments” in line 1: ‘must be consistent with the approved Schedule of Values and’
Add Sections 9.3.1.3 through 9.3.1.5 to Section 9.3.1:

§ 9.3.1.3 Until Substantial Completion the Owner shall pay 95% of the amount due the Contractor on account of progress payments.

§ 9.3.1.4 The Owner’s release of retained funds and final payment to the Contractor shall be made in accordance with Iowa Code Chapters 26 and 573 provisions.

§ 9.3.1.5 Progress Payments shall be made monthly upon application. Monthly estimates will be paid to the Contractor as the Work progresses in amounts equal to ninety-five percent (95%) of the Contract value of the Work completed during preceding calendar month, including actual cost of materials and equipment of permanent nature to be incorporated in the Work, and delivered to and stored at the job site. Such monthly payments shall in no way be construed as an act of acceptance for any part of the Work, partially or totally completed. The Contractor shall submit a final application for payment of retainage at conclusion of Project. Final payment of five percent (5%) due the Contractor will be paid not earlier than thirty-one (31) days from date of final acceptance of Work by Owner, and after receipt of satisfactory evidence that all claims pertaining to such Contract have been paid in full as approved in Contract Documents for said Work.

§ 9.5 Decisions to Withhold Certification

Add following at end of Section 9.5.1:

.8 Service work not attended to;
.9 Evidence of lack of careful workmanship;
.10 Unworkmanlike or over expeditious construction;
.11 Lack of attention to special field duties specified.

Delete Section 9.5.4 in its entirety.

§ 9.6 Progress Payment

Add the words ‘following Board approval’ between the words ‘payment’ and ‘in’ in 1st line of Section 9.6.1.

Add Section 9.6.1.1 to 9.6.1 as follows:

§ 9.6.1.1 Owner will, within 30 days of presentation to them of Notarized Certificate for Payment, pay Contractor progress payment on basis of approved Application for Payment. Laws of State of Iowa shall be followed regarding Contractor Payment. Final payment shall be made no sooner than 31 days following final approval and acceptance of completed Project.
Delete Paragraph 9.6.4 and substitute the following:

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

Modify Section 9.6.8 by deleting the word 'lien' throughout and replacing it with the words 'Iowa Code Chapter 573.'

Add Section 9.6.8.1 to Section 9.6 as follows:

§ 9.6.8.1 Payment to Contractor will be made by Owner from cash on hand from such sources as may be legally available.

§ 9.7 Failure of Payment

Delete Section 9.7 and substitute the following:

If Owner does not pay the Contractor within sixty (60) days after the Contractor submits an Application for Payment to the Architect, the Contractor may file a claim in accordance with Article 15 of this Contract.

§ 9.8 Substantial Completion

Add the following at end of Section 9.8.1:

', subject only to completion of minor punch list items, the absence of completion of which does not interfere with Owner's intended use of Project. The Contractor assumes the responsibility for notifying the Architect in writing when the Project is complete and ready for inspection and review by Architect. This letter to the Architect shall include the date after which the Contractor will be ready for final review and inspection. Designated portions of the Work will be reviewed separately.'

Add Section 9.8.3.1 to Section 9.8.3:

9.8.3.1 The Architect/Engineer will perform no more than 2 inspections to determine whether the Work or a designated portion thereof has attained Substantial Completion in accordance with the Contract Documents. The Owner is entitled to reimbursement from the Contractor for amounts paid to the Architect/Engineer for any additional inspections.
Add Sections 9.8.6 through 9.8.9 to Section 9.8:

§ 9.8.6 Contractor must make all corrections on the punch list prior to notifying Architect of its completion as outlined in Section 9.10. The Contractor shall reimburse Owner for any Architect/Engineer’s Additional Services and/or attorney’s fees incurred as result of Contractor’s failure to finally complete Work within 60 days after date specified in Contract Documents for Project Substantial Completion, or subsequently modified by Change Order or dates established in the Certificate of Substantial Completion. Reimbursement for these additional services will be deducted by the Owner from the amounts due the Contractor and paid directly to the Architect/Engineer. For purposes of this Paragraph ‘incurred as result of’ includes any Architectural fees charged to Owner as Additional Fees under contract due to fact that services were performed 60 days (or some other amount of time specified in Architect/Engineer Agreement) after Substantial Completion. Nature of services performed (and whether they would have otherwise been performed as normal closeout services at some point under Basic Services) is not relevant to Contractor’s obligations for reimbursement under this section if contract between Owner and Architect/Engineer states that any services and related fees are defined as Additional Services solely because they were performed more than 60 days (or some other amount of time specified in Owner/Architect/Engineer Agreement) after Substantial Completion.

§ 9.8.7 Upon achieving Substantial Completion, as defined by Iowa Code Chapter 26, the Contractor may request release of all or part of retained funds due in accordance with Iowa Code Chapter 26 provisions. Remaining retained funds shall not become due until the Contractor submits to the Architect/Engineer:

.1 Sworn statement that 10 calendar days prior to filing request for release of retained funds, a notice was given to all known subcontractors, sub-subcontractors, and suppliers that Contractor was requesting release of retained funds. The notice shall be substantially similar to the following:

‘Notice of Contractor’s Request for Early Release of Retained Funds’

‘You are hereby notified that [name of contractor] will be requesting an early release of funds on a public improvement Project designated as Parkview Middle School Renovation & System Upgrades – Phase 2 for which you have or may have provided labor or materials. The request will be made pursuant to Iowa Code section 26.13. The request may be filed with the Ankeny Community School District after ten calendar days from the date of this notice. The purpose of the request is to have Ankeny Community School District release and pay funds for all work that has been performed and charged to Ankeny Community School District as of the date of this notice. This notice is provided in accordance with Iowa Code section 26.13.’
.2 Itemized list of Work left to complete, including estimated value of labor and materials.
.3 Itemized list of Iowa Code Chapter 573 claims currently on file at time request for release of retained funds is received.
.4 Written confirmations from governmental agencies that all permit and inspection fees have been paid by Contractor.
.5 Operation, Maintenance, and Warranty Manuals and Record Drawings and Specifications.

§ 9.8.8 If proper documentation requested in Subparagraph 9.8.7 is received from Contractor, Owner shall make payment due Contractor at Owner’s next monthly board meeting or within 30 days, whichever is less, except the Owner may retain the following to the extent authorized by law:

.1 An amount equal to 200% of the value of labor and materials yet to be provided on the Project as determined by the Owner and its authorized contract representative. For purposes of this Section, “authorized contract representative” means the Architect. Final values to be withheld shall be determined by the Architect/Engineer based on initial estimates provided by Contractor and Architect/Engineer’s on-site visits and observations.
.2 Double the amount of any Iowa Code Chapter 573 claims currently on file.
.3 An amount equal to 1/2% of the total value of the Project for Operation, Maintenance, and Warranty Manuals and Record Drawings and Specifications not submitted 10 days prior to Substantial Completion inspection.

§ 9.8.9 If the Owner withholds any amounts of retained funds, the Architect/Engineer, on behalf of the Owner, shall provide an itemization and list of reasons why amounts are being withheld within 30 calendar days of receipt of request. Add the Sections 9.8.10 through 9.8.13 as follows:

§ 9.8.10 Warranties required by the Contract Documents will commence on the Date of Substantial Completion of the Work unless otherwise provided in the Certificate of Substantial Completion or the Contract Documents.

§ 9.8.11 Upon execution of the Certificate of Substantial Completion, the Contractor will deliver custody and control of such Work to the Owner. The Owner will thereafter provide the Contractor reasonable access to such Work to permit the Contractor to fulfill the correction, completion and other responsibilities remaining under the Contract and the Certificate of Substantial Completion.

§ 9.8.12 Unless otherwise provided in the Certificate of Substantial Completion, the Contractor must complete or correct all items included in the final Punch List within sixty (60) days, subject to the availability of special order parts and materials, after the Date of Substantial Completion.
§ 9.8.13 At the time of Substantial Completion, in addition to removing rubbish and leaving the building “broom clean,” the Contractor must replace any broken or damaged materials, remove stains, spots, marks and dirt from decorated Work, clean all fixtures, vacuum all carpets and wet mop all other floors, replace HVAC filters, clean HVAC coils, and comply with such additional requirements, if any, which may be specified in the Contract Documents.

§ 9.10 Final Completion and Final Payment

Delete Sections 9.10.1 through 9.10.5.

Add Sections 9.10.1 and 9.10.1.1 as follows:

§ 9.10.1 When Contractor has completed or corrected all items on final Punch List and considers that Work is complete and ready for final acceptance, Contractor shall give written notice to Owner and Architect/Engineer and request final inspection of Work as provided in Section 9.10.2. Contractor’s notice and request for final inspection shall be accompanied by final Application for Payment and Submittals required by Section 9.10.3.

§ 9.10.1.1 The Architect/Engineer will perform no more than 2 inspections to determine whether the Work or a designated portion thereof has attained Final Completion in accordance with the Contract Documents. The Owner is entitled to reimbursement from the Contractor for amounts paid to the Architect/Engineer for any additional inspections. Add Section 9.10.2 as follows:

§ 9.10.2 Upon receipt of Contractor’s notice and request for final inspection, Owner and Architect/Engineer shall promptly make such inspection and, when Owner and Architect/Engineer concur that Work has been fully completed and is acceptable under Contract Documents, Architect/Engineer will issue Certificate of Final Completion to Owner. Contractor’s notice and request for final inspection constitutes representation by Contractor to Owner and Architect/Engineer that the Work has been completed in full and strict accordance with terms and conditions of Contract Documents. Architect/Engineer will promptly notify Contractor if Owner and Architect/Engineer do not concur that Work is finally complete. In such case, Contractor shall bear cost of any additional services or inspection of Owner or Architect/Engineer until Work is determined to be finally complete.

Add Section 9.10.2.1 to Section 9.10.2:

§ 9.10.2.1 The Contractor shall provide Project Record Documents, Operation and Maintenance Manuals, Instruction to Owner’s personnel, Final Cleaning and other closeout procedures specified elsewhere.
Add Section 9.10.3 as follows:

§ 9.10.3 Final Payment will be made no earlier than 31 days following approval of Board at regularly scheduled meeting, receipt of all Lien Waiver(s) and/or Chapter 573 Claim Releases, Sales Tax Information, and all other required closeout documents, and are subject to conditions of and in accordance with provisions of Iowa Code Chapter 573 and Iowa Code Chapter 26. Owner may withhold from final payment any and all amounts required to reimburse Owner for all costs, fees (including reasonable attorney's fees) incurred as result of any Chapter 573 Claims filed on Project. Neither final payment nor any remaining retained percentage will become due until Contractor submits following documents to Architect/Engineer.

.1 Affidavit that payrolls, bills for materials and equipment, and other indebtedness with Work for which Owner or Owner’s property might be responsible or encumbered (less amounts withheld by Owner), have been paid or otherwise satisfied, submitted on AIA Document G706, Affidavit of Payment of Debts and Claims (latest edition) or such other form as may be prescribed by Owner;

.2 Release or waiver of liens on behalf of Contractor and similar release or waiver on behalf of each Subcontractor and supplier, accompanied by AIA Document G706A, Affidavit of Release of Liens (latest edition) or such other form as may be prescribed by Owner;

.3 Certificate evidencing that Contractor’s liability insurance and Performance Bond remain in effect during one-year correction period following Substantial Completion as set forth in Section 12.2.2.1 and 12.2.2.2;

.4 Written statement that Contractor knows of no substantial reason that insurance will not be renewable to cover period required by Contract Documents;

.5 Consent of surety to final payment submitted on AIA Document G707 (latest edition) or other form prescribed by Owner;

.6 Other data required by Owner establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of Contract, to extend and in such forms as may be prescribed by Owner;

.7 Certified building location survey and as-built site plan in form and number required by Contract Documents

.8 All warranties and bonds required by Contract Documents; and

.9 Record Documents and return of Contract Documents as provided therein.
Add Section 9.11 to Article 9:

§ 9.11 ASSIGNMENT

§ 9.11.1 No assignment by the Contractor of any principal contract or any part thereof, or of the funds to be received thereunder by the Contractor, will be recognized unless such assignment has had the written approval of the Owner and the Surety has been given due notice of such assignment and has furnished written consent thereto. In addition to the usual recitals in the Assignment Contract, the following language must be set forth:

“It is agreed that the funds to be paid to the Assignee under this Assignment are subject to prior lien/Iowa Code Chapter 573 claims for services rendered on materials supplied for the performance of all work called for in said Contract, in favor of all persons, firms or corporations rendering such services supplying such materials.”

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.2 Safety of Persons and Property

Add Section 10.2.4.1 to Section 10.2.4:

§ 10.2.4.1 When use or storage of explosives, or other hazardous materials, substances or equipment, or unusual methods are necessary for execution of the Work, the Contractor shall give the Owner reasonable advance notice.

Add Section 10.2.5.1 to Section 10.2.5:

§ 10.2.5.1 Contractors required remedial action for damage and loss to property referred to in Sections 10.2.1.2 and 10.2.1.3 shall repair the damaged materials and surfaces to their original condition, or better, to the satisfaction of the Owner. All such repairs are the responsibility of the Contractor and shall be accomplished at no additional cost to the Owner.

Add Section 10.2.9 to Section 10.2:

§ 10.2.9 Contractor shall at all times, protect the excavation, trenches and/or the buildings from damage or rain water, spring water, ground water, backing up of drains, or sewers, etc. Provide all pumps, equipment, and enclosures to give this protection.

Contractor shall construct and maintain all necessary temporary drainage and do all pumping necessary to keep excavations free of water.

Contractor shall provide all shoring, bracing, and sheeting as required for safety and for the proper execution of the Work. Remove when work is completed.
At end of day’s work, all new work likely to be damaged shall be covered. During cold weather protect all work from damage. If low temperatures make it impossible to continue operations safely in spite of cold weather precautions, work shall cease after notifying Architect/Engineer. All other protective measures not mentioned above which may be required shall be furnished by the particular Contractor responsible for such protection.

§ 10.4 Emergencies

Delete Section 10.4 and substitute the following:

In an emergency affecting safety of persons or property, the Contractor must take all necessary action, without the necessity for any special instruction or authorization from the Owner or Architect, to prevent threatened damage, injury or loss. The Contractor must promptly, but in all events with twenty-four (24) hours of the emergency, report such action in writing to the Owner and Architect. If the Contractor incurs additional costs on account of or is delayed by such emergency, the Contractor may request a change in the Contract Sum or Contract Time to account for such additional costs or delay in accord with Articles 7, 8 and 15. The Contractor must file any such request within ten (10) days of the emergency or it is deemed waived. Any adjustment in the Contract Sum or Contract time shall be limited to the extent that the emergency work is not attributable to the fault or neglect of the Contractor or otherwise the responsibility of the Contractor under the Contract Documents.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor’s Liability Insurance

Add Sections 11.1.2.1 through 11.1.2.5 to Section 11.1.2:

§ 11.1.2.1 The limits for Worker’s Compensation and Employer’s Liability insurance shall meet statutory limits mandated by State and Federal Laws.

Contractor shall endorse their Worker’s Compensation policy to contain waiver of subrogation in favor of Owner.

§ 11.1.2.2 The limits for Commercial General Liability insurance including coverage for Premises-Operations, Independent Contractors’ Protective, Products-Completed Operations, Contractual Liability, Personal Injury and Broad Form Property Damage (including coverage for Explosion, Collapse and Underground hazards) shall be as indicated in Appendix C – Contractor Insurance Requirements, or greater if required by law.

.1 The policy shall be endorsed to have the General Aggregate apply to this Project only.
.2 The Contractual Liability insurance shall include coverage sufficient to meet the obligations of AIA Document A201-2017 under Paragraph 3.18.
.3 Products and Completed Operations insurance shall be maintained for a minimum period of at least 2 years after the expiration of the period for correction of Work.
.4 Policy shall be endorsed to contain a waiver of subrogation in favor of the Owner.

§ 11.1.2.3 Automobile Liability insurance (owned, non-owned and hired vehicles) for bodily injury and property damage shall be as indicated in Appendix C – Contractor Insurance Requirements, or greater if required by law.

§ 11.1.2.4 Umbrella or Excess Liability coverage shall be as indicated in Appendix C – Contractor Insurance requirements, or greater if required by law.

§ 11.1.2.5 General Liability coverages shall be provided by a Commercial General Liability Policy on an occurrence basis, the policy date shall predate the Contract; the Owner, Architect/Engineer, and all Subconsultants shall be named as additional insured; the termination date of the policy or applicable extended reporting period shall be no earlier than the termination date of coverages required to be maintained after final payment, certified in accordance with Subparagraph 9.10.2.

All liability policies which include the Owner as an additional insured shall include a Governmental Immunities Endorsement pursuant to Chapter 670.4 of the Iowa Code, which endorsement shall include the following provisions:

.1 Non-Waiver Government Immunity: The insurance carrier expressly agrees and states that the purchase of this policy and including the Owner as an Additional Insured does not waive any of the defenses of governmental immunity available to the Owner under Iowa Code Section 670.4 as it now exists and as it may be amended from time to time.

Add the following sentence to Section 11.1.3:

‘If this insurance is written on a Commercial General Liability policy form, the certificates shall be ACORD Form 25. 1 copy of ACORD Form 25 shall be submitted with each Agreement.’

§ 11.1 Contractor’s Insurance and Bonds

Add Sections 11.1.2.1 and 11.1.2.2 to Section 11.1.2:

§ 11.1.2.1 The Contractor shall, at the Contractor’s own expense provide insurance coverage for materials stored off the site after written approval of the Owner at the value established in the approval, and also for portions of the Work in transit until such materials are permanently attached to the Work.
§ 11.1.2.2 The insurance required by Section 11.1 is not intended to cover machinery, temporary structures and buildings, tools or equipment owned or rented by the Contractor that are utilized in the performance of the Work but not incorporated into the permanent improvements. The Contractor shall, at the Contractor's own expense, provide insurance coverage for owned or rented machinery, tools or equipment, which shall be subject to the provisions of Subparagraph 11.3.

§ 11.2 Owner's Insurance

Add the following sentence to Section 11.2:

Owner's “all risk” insurance will be provided by Owner with customary exclusions of certain perils.

Add Section 11.6:

§ 11.6 Performance Bond and Payment Bond

Add Sections 11.6.1 – 11.6.3 to Section 11.6:

§ 11.6.1 The Contractor shall furnish bonds covering faithful performance of the Contract and payment of obligations arising thereunder. Bonds may be obtained through the Contractor's usual source and the cost thereof shall be included in the Contract Sum. The amount of each bond shall be equal to 100% of the Contract Sum.

§ 11.6.2 The Contractor shall deliver the required bonds to the Owner not later than 10 days following contract award or 3 days following the date this Agreement is entered, whichever is less. If the Work is to be commenced prior thereto in response to a letter of intent, the Contractor shall, prior to the commencement of the Work, submit evidence satisfactory to the Owner that such bonds will be furnished.

§ 11.6.3 The Contractor shall require the bonding company to be registered with authority to transact business in State of Iowa.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

Add the words ‘upon written authorization from Owner’ between the words ‘Architect’ and ‘be uncovered’ in 2nd line of Section 12.1.1.

Add the words ‘upon written authorization from Owner’ between the words ‘any request’ and ‘to see’ in 2nd line of Section 12.1.2.
§ 12.2.2 After Substantial Completion

Delete Section 12.2.1 and substitute the following:

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

Delete Section 12.2.2.1 and substitute the following:

§ 12.2.2.1 In addition to Contractor's obligations under Section 3.5, if, within 2 years after date of Final Completion of Work or designated portion thereof or after date of commencement of warranties established under any other provision of Contract Documents, or by terms of an applicable special warranty required by Contract Documents, any of Work is found not to be in accordance with requirements of Contract Documents, Contractor shall correct it promptly after receipt of written notice from Owner to do so. Owner shall give such notice promptly after discovery of condition. Before commencing correction of Work, Contractor shall submit to Owner written description of their proposed repairs. This proposal shall be approved by Design Professional before Contractor commences repair. Once Contractor has completed repair work, they shall notify Owner and Design Professional who shall promptly review corrected work. If Design Professional or Owner rejects corrected Work, Contractor shall continue with repairs until such time as Design Professional and Owner accept corrected Work. Where Contractor corrects defective Work during initial 2 year period after Final Completion, if Owner discovers defects in corrected Work within 1 year after repairs are made, then Contractor shall be obligated, upon written notice from Owner, to correct such defects within 1 year from date that repairs were made.

Add Section 12.2.6 to Section 12.2 as follows:

§ 12.2.6 If Contractor fails or refuses to correct Work in accordance with their obligations under Contract Documents after written notice from Owner, then Owner may correct Work and Contractor shall be liable for costs to correct Work, any related architectural, engineering or other consulting costs, attorney's fees and expenses, and fines or penalties, if any. Any amounts due to Owner from Contractor under this Section may be withheld from balance of Contract Sum not yet paid.
ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law
Delete Section 13.1 and substitute the following:

§ 13.1 Governing Laws
The Contractor shall be governed by the laws of the State of Iowa.

Add Section 13.1.1 to Section 13.1 as follows:

§ 13.1.1 Compliance with Law Provision: The Contractor agrees that it will comply with all applicable Federal, State and local laws, statutes, codes, rules, and regulations having jurisdiction over the Project. Contractor shall take all necessary precautions to keep the site and work in compliance with the safety and health regulations for construction issued by the Bureau of Labor Standards of the U.S. Department of Labor as well as the Occupational Safety and Health Standards, as amended and as enforced by the State of Iowa.

§ 13.2 Successors and Assigns
Delete Section 13.2.2.

§ 13.4 Tests and Inspections
Add the following after the 2nd sentence in Section 13.5.1:

‘Contractor shall schedule all tests, inspections, or specific approvals required by law or Contract Documents so as to avoid any delay in Work.’

Delete last 2 sentences of Section 13.4.1.

Add Section 13.4.7 to Section 13.4.

§ 13.4.7 In addition to tests required by Section 13.5, Owner may at any time arrange for other tests, inspections and specific approvals to be performed by others selected by Owner, at Owner’s expense. Contractor shall cooperate with Owner and provide access to Work for such tests, inspections and approvals.
§ 13.5 Interest

Delete Section 13.5 text and substitute the following:

‘Payments due and unpaid under Contract Documents shall bear interest from date payment is due and shall bear interest at rate established in Iowa Code Section 74A.2 or Iowa Code Section 573.14, whichever is less.’

Add Sections 13.6 through 13.11 to Article 13:

§ 13.6 Owner’s Right to Occupy
Owner shall have the right to occupy, without prejudice to rights of either party, any completed or largely completed portion of structure or Work, notwithstanding the fact that time for completing entire Work, or such portion thereof, may not have expired. Such occupancy and use shall not be an acceptance of Work taken or used.

§ 13.7 Rebates
Owner shall have the right to apply for, and secure all rebates which are available when Bids are received. Contractor shall provide invoices, itemizations, and cooperation to the Owner in this regard.

§ 13.8 Conformance with Laws
The Contractor shall conform with provisions of Federal Civil Rights Act, the Code of Iowa, Chapter 216 Civil Rights Commission and rules and regulations adopted thereto by the Iowa Civil Rights Commission. The Contractor shall comply with applicable federal, state, and local laws, rules, regulations, ordinances, policies and procedures, including Owner’s policies and procedures, and Iowa Smoke Free Air Act. The Contractor shall require similar clauses in all of their subcontracts for service or materials.

§ 13.9 Equal Opportunity
§ 13.9.1 The Contractor shall maintain policies of employment as follows:

§ 13.9.1.1 The Contractor and the Contractor's Subcontractors shall not discriminate against any employee or applicant for employment because of race, creed, religion, color, sex, national origin, ancestry, age, mental or physical disability, sexual orientation and gender identity. The Contractor shall take affirmative action to insure that applicants are employed, and that employees are treated during employment without regard to their race, creed, religion, color, sex or national origin, ancestry, age, mental or physical disability, sexual orientation or gender identity. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the policies of non-discrimination.
§ 13.9.1.2 The Contractor and the Contractor's Subcontractors shall, in all solicitations or advertisements for employees placed by them or on their behalf, state that all qualified applicants will receive consideration for employment without regard to race, creed, religion, color, sex, national origin, ancestry, age, mental or physical disability, sexual orientation and gender identity.

§ 13.10 Closeout Documentation
Not later than 10 days after the date of Substantial Completion, the Contractor shall furnish to the Architect/Engineer all Closeout Documentation identified in General Requirements (Division 1 of the Specifications). Except with the consent of the Owner, the Architect/Engineer will perform Closeout Documentation review only during the 60 day period following Substantial Completion. The Owner shall be entitled to deduct from the Contract Sum amounts paid to the Architect/Engineer for additional reviews beyond the 60 day time period identified.

§ 13.11 Confidential Information
If the Owner or Contractor receives information specifically designated by the other party as 'confidential' or 'business proprietary', the receiving party shall keep such information strictly confidential and shall not disclose it to any other person except to (1) those who need to know the content of such information in order to perform services or construction solely and exclusively for the Project, including its employees, or (2) its consultants and contractors whose contracts include similar restrictions on the use of confidential information. However, the party receiving 'confidential' or 'business proprietary' information may disclose such information, after 7 days’ Notice to the party providing the confidential or business proprietary information, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by arbitrator(s) order. Notice shall be provided, and deemed to have been duly served, in accordance with 1.6.2 of A201-2017.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

Delete Section 14.1.1 and substitute the following:

§ 14.1.1 Contractor has no right to stop Work as consequence of non-payment. In event of any disagreement between Contractor and Owner involving Contractor's entitlement to payment, Contractor's only remedy is to file Claim in accordance with Article 15. Contractor shall diligently proceed with Work pending resolution of Claim.

.1 If, however, an Application for Payment has been approved for payment by Owner, and Owner fails to make payment within 60 days of approval of payment by Owner, Contractor may upon 10 day written notice to Owner, stop work if payment is not made by Owner within 10 days following notice.

Delete Sections 14.1.2 through 14.1.4 in their entirety.
§ 14.2 Termination by the Owner for Cause

Delete Sections 14.2.1 through 14.2.4 and substitute the following:

§ 14.2.1 Owner may terminate Contract for cause if Contractor:

.1 Fails to supply adequate properly skilled workers or proper materials;
.2 Fails to make payment to Subcontractors or Suppliers for materials or labor in accordance with respective agreements between Contractor and Subcontractors or Suppliers;
.3 Fails to comply with any laws, ordinances, or rules, regulations or orders of public authority having jurisdiction;
.4 Fails to perform Work in accordance with Contract Documents or otherwise breaches any provision of Contract Documents;
.5 Anticipatorily breaches or repudiates Contract;
.6 Fails to make satisfactory progress in prosecution of Work required by Contract; or
.7 Endangers performance of Contract.

§ 14.2.2 Owner may terminate Contract, in whole or in part, whenever Owner determines that sufficient grounds for termination exist as provided in Section 14.2.1. Owner will provide Contractor with written notice to cure default. If default is not cured, termination for default is effective on date specified in Owner's written notice. However, if Owner determines that default contributes to curtailment of an essential service or poses an immediate threat to life, health, or property, Owner may terminate Contract immediately upon issuing oral or written notice to Contractor without any prior notice or opportunity to cure. In addition to any other remedies provided by law or Contract, Contractor shall compensate Owner for additional costs that foreseeably would be incurred by Owner, whether costs are actually incurred or not, to obtain substitute performance. Termination for default is termination for convenience if termination for default is later found to be without justification.

§ 14.2.3 Upon receipt of written notice from Owner of termination, Contractor shall:

.1 Cease operations as directed by Owner in notice and, if required by Owner and County, participate in an inspection of Work with Owner, County and Architect/Engineer to record extent of completion thereof to identify Work remaining to be completed or corrected, and to determine what temporary facilities, tools, equipment and construction machinery are to remain at Site pending completion of Work;
.2 Complete or correct items directed by Owner, and take actions necessary, or that Owner may direct, for protection and preservation of any stored materials and equipment and completed Work;
.3 Unless otherwise directed by Owner, remove their tools, equipment and construction machinery from Site; and
.4 Except as directed by Owner, terminate all existing subcontracts and purchase orders and enter into no further subcontracts or purchase orders.
§ 14.2.4 Following written notice from Owner of termination, Owner may:
   .1 Take possession of Site and all materials and equipment thereon, and at Owner's option, such temporary facilities, tools, construction equipment and machinery thereon owned or rented by Contractor that Owner elects to utilize in completing Work;
   .2 Accept assignment of subcontracts and purchase orders, and
   .3 Complete Work by whatever reasonable method Owner may deem expedient.

Add Sections 14.2.5 through 14.2.9 to Section 14.2:

§ 14.2.5 Upon termination for cause, Contractor shall take those actions described in Section 14.2.3, and Owner may take those actions described in Section 14.2.4, subject to prior rights of Contractor's Surety, as applicable.

§ 14.2.6 When Owner terminates Contract for cause, Contractor is not entitled to received further payment until Work is completed and costs of completion have been established.

§ 14.2.7 If unpaid balance of Contract Sum less amounts which Owner is entitled to offset from unpaid Contract balance, including actual or Liquidated Damages, compensation for Architect/Engineer's services and expenses made necessary thereby, and other damages and expenses incurred by Owner, including reasonable attorney's fees, exceeds cost of completing Work, including compensation for Owner's and Architect/Engineer's services made necessary thereby, such excess will be paid to Contractor or Surety, as directed by Surety. If such costs exceed unpaid Contractor balance, Contractor shall pay difference to Owner upon written demand. This obligation for payment shall survive termination of Contract.

§ 14.2.8 In completing Work following termination for cause, Owner is not required to solicit competitive bids or to award completion work to lowest bidder, but may obtain such completion work and related services on basis of sole source procurement and negotiated compensation.

§ 14.2.9 If Contractor files for protection, or petition is filed against it, under Bankruptcy laws, and Contractor wishes to affirm Contract, Contractor shall immediately file with Bankruptcy Court motion to affirm Contract and shall provide satisfactory evidence to Owner and to Court of their ability to cure all present defaults and their ability to timely and successfully complete Work. If Contractor does not make such an immediate filing, Contractor accepts that Owner shall petition Bankruptcy Court to lift Automatic Stay and permit Owner to terminate Contract.
§ 14.4 Termination by the Owner for Convenience

Delete Sections 14.4.1 through 14.4.3 and substitute the following:

§ 14.4.1 Owner may, at any time, terminate the Contract or any portion thereof or Work for Owner's convenience and without cause.

§ 14.4.2 Upon receipt of written notice from Owner of termination, Contractor shall:
.1 Cease operations as directed by Owner in notice and, if required by Owner, participate in inspection of Work with Owner and Architect/Engineer to record extent of completion thereof, to identify Work remaining to be completed or corrected, and to determine what temporary facilities, tools, equipment and construction machinery are to remain at Site pending completion of Work;
.2 Complete or correct items directed by Owner, and take actions necessary, or that Owner may direct, for protection and preservation of stored materials and equipment and completed Work.
.3 Unless otherwise directed by Owner, remove their tools, equipment and construction machinery from Site, and
.4 Except as directed by Owner, terminate all existing subcontracts and purchase orders related to Work and enter into no further subcontracts of purchase orders thereof.

§ 14.4.3 Following written notice from Owner of termination, the Owner may:
.1 Take possession of Site and of all materials and equipment thereon, at Owner's option, such temporary facilities, tools, construction equipment and machinery thereon owned or rented by Contractor that Owner elects to utilize in completing Work;
.2 Accept assignment of subcontracts and purchase orders; and
.3 Complete Work by whatever reasonable method Owner may deem expedient.

Add Section 14.4.4 and 14.4.5 to Section 14.4:

§ 14.4.4 In case of termination for Owner's convenience, Contractor will be entitled to compensation only for following items:
.1 Payment for acceptable Work performed up to date of termination;
.2 Costs of preservation and protection of Work if requested to do so by Owner;
.3 Cost of terminating following contracts including:
   a. Purchased materials but only if not returnable and provided to Owner, or restocking or return charge, if any, if returnable at Owner's written election;
   b. Equipment rental contracts if not terminable at no cost but not to exceed an amount equal to 30 day rental;
c. Documented transportation costs associated with removing Contractor-owned equipment;
d. Documents demobilization and close-out costs; and
e. Overhead and profit on foregoing not to exceed 10 percent.

.4 Contractor will not be compensated for cost of terminating subcontracts, which shall be terminable at no cost to Owner if Contract is terminated.

.5 Contractor will not be compensated for cost of any idled employees unless employee is underwritten employment contract entitling employee to continued employment after termination of Contract and employee cannot be assigned to other Work provided that in all events Contractor's costs shall be limited to thirty (30) days of employment costs from date of notice of termination. Contractor shall not be entitled to any other costs or compensation (including lost or expected profit, uncompensated overhead or related expenses, or cost of preparing and documenting their compensable expenses under this Section 14.4.4 as consequence of Owner's termination of Contract for convenience). Contractor conclusively and irrevocably waives their right to any other compensation or damages (compensation or Punitive) arising from termination of Contract. If Owner and Contractor are unable to agree upon amounts specified in this Section, Contractor may submit Claim as provided in Article 15. Claim must be limited to resolution of amounts specified in Section 14.4.4.1, 14.4.4.2, 14.4.4.3, and 14.4.4.4 of Section 14.4.4. No other cost, damages or expenses may be claimed or paid to Contractor or considered as part of Claim, same being hereby conclusively and irrevocably waived by Contractor. Any such Claim shall be delivered to Owner within 30 days of termination of Contract and shall contain written statement setting forth specific reasons and supporting calculations and documentation as to amounts Contractor claims to be entitled to under this Section as result of termination of Contract.

§ 14.4.5 Contractor's obligations surviving final payment under Contract, including without limitation those with respect to insurance, indemnification, and correction of Work that has been completed at time of termination, remains effective notwithstanding termination for convenience of Owner.
ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1.1 Definition

Delete Section 15.1.1 text and substitute the following:

‘A Claim is a written demand or assertion by Contractor seeking, as matter of right, payment of money, a change in the Contract Time, or other relief with respect to terms of Contract. Responsibility to substantiate Claims shall rest with Contractor. Nothing contained in this section is intended to apply to or in any way limit Owner's right to make claims related to or arising out of Contract.’

§ 15.1.2 Time Limits on Claims

Delete the words “Substantial Completion” in line 4 of Section 15.1.2 and replace it with “Final Acceptance.”

Delete the last sentence of Section 15.1.2

§ 15.1.3 Notice of Claims

Delete Section 15.1.3.1 and substitute the following:

§ 15.1.3.1 Claims by Contractor shall be initiated by written notice to Owner and to Initial Decision Maker with copy sent to Architect/Engineer, if Architect/Engineer is not serving as Initial Decision Maker. Claims by Contractor shall be initiated within ten (10) days after occurrence of event giving rise to such Claim or within ten (10) days after Contractor first recognizes condition giving rise to Claim, whichever is later. As condition of making claim for additional costs, Contractor shall maintain and produce accurate records to substantiate all additional costs actually incurred. If Claim for actual cost is approved, Owner shall pay Contractor actual costs incurred plus either (a) ten percent (10%) for overhead and profit for work performed by Contractor, or (b) five percent (5%) overhead and profit for work performed by subcontractor, as applicable.’

§ 15.1.4 Continuing Contract Performance

Delete Section 15.1.4.1 and substitute the following:

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

Delete Section 15.1.4.2.
§ 15.1.6 Claims for Additional Time

Delete Section 15.1.6.2 and substitute the following:

§ 15.1.6.2 If adverse weather conditions are the basis of a Claim for additional time, the Claim shall be documented by data substantiating that the weather conditions upon which the Claim is based (1) were abnormal when compared to the previous 5-year period, during the same time frame and at the location of the Work, (2) could not have been reasonably anticipated, and (3) had an adverse effect on the date of substantial completion of the Work.

Add Sections 15.1.6.3 and 15.1.6.4 to Section 15.1.6:

§ 15.1.6.3 Claims for increase in the Contract Time shall set forth in detail the circumstances that form the basis for the Claim, the date upon which each cause of delay began to affect the progress of the Work, the date upon which each cause of delay ceased to affect the progress of the Work and the number of days' increase in the Contract Time claimed as a consequence of each such cause of delay. The Contractor shall provide such supporting documentation as the Owner may require including, where appropriate, a revised construction schedule indicating all the activities affected by the circumstances forming the basis of the Claim.

§ 15.1.6.4 The Contractor shall not be entitled to a separate increase in the Contract Time for each one of the number of causes of delay which may have concurrent or interrelated effects on the progress of the Work, or for concurrent delays due to the fault of the Contractor.

§ 15.1.7 Waiver of Claims for Consequential Damages

Delete Section 15.1.7.

§ 15.2 Initial Decision

Modify the first sentence of Section 15.2.1 to read as follows:

“Claims, excluding those arising under Sections 10.3, 10.4 and 11.5 shall be referred to the Initial Decision Maker for initial decision.”

Delete Section 15.2.6 as substitute the following:

§ 15.2.6 The parties may file for mediation of an initial decision at any time, upon mutual agreement of the parties.

Delete Section 15.2.6.1.
Delete Section 15.2.8.

§ 15.3 Mediation

Delete Section 15.3.1.

Delete Section 15.3.2 and substitute the following:

§ 15.3.2 The parties shall endeavor in good faith to resolve claims, disputes and other matters in question between them by mutual agreement and may, by mutual agreement and in their discretion, submit same to non-binding mediation which shall be in accordance with Iowa Code Chapter 679C. Requests for mediation shall be given in writing to the other Party to this Agreement. If the Owner and Contractor are unable to mutually agree upon mediator in writing within sixty days of receiving written request for mediation, either party may then institute legal or equitable proceedings. Mediation shall be voluntary only and shall not be a prerequisite to litigation or other means of dispute resolution.

Delete Section 15.3.3

Delete Section 15.4 substitute the following:

§ 15.4 Litigation

§ 15.4.1 Any legal claim brought under this Agreement shall be filed in the Iowa District Court in and for Dallas County, unless otherwise mutually agreed to by the parties.

Add Article 16 as follows:

ARTICLE 16 SMOKING AND RELATED ADVERTISING

§ 16.1 Smoking will not be allowed on Owner's property, which shall include inside private vehicles parked on Owner's property. In addition, employees of Contractor, Subcontractors, and materials suppliers shall not wear apparel that advertises tobacco, alcohol, or illicit drugs, nor has profane language or images on them.

END OF DOCUMENT
APPENDIX A

CAD/ELECTRONIC FILE TRANSFER LETTER

[Date]

Name
Address
City, State Zip

Re:

Dear

At your request, frk architects + engineers (FRK-AE) will provide electronic files for your convenience and sole use in the preparation of shop drawings related to: (Insert name of project), subject to the following terms and conditions:

Our electronic files are compatible with: IBM Compatible AutoCAD with ADT (Confirm version with FRK). FRK-AE makes no representation as to the compatibility of these files with your hardware or your software beyond the specified release of the referenced specifications.

Data contained on these electronic files is part of our instruments of service and shall not be used by you for any purpose other than as a convenience in the preparation of shop drawings for the referenced project. Any other use or reuse by you will be at your sole risk and without liability or legal exposure to FRK-AE. You agree to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of action of any nature against FRK-AE, its officers, directors, employees, agents or sub-consultants which may arise out of or in connection with your use of the electronic files.

Furthermore, you shall, to the fullest extent permitted by law, indemnify and hold harmless FRK-AE from all claims, damages, losses and expenses, including attorneys’ fees arising out of or resulting from your use of these electronic files.

These electronic files are not contract documents. Significant differences may exist between these electronic files and corresponding hard copy contract documents due to addenda, change orders or other revisions. FRK-AE makes no representation regarding the accuracy or completeness of the electronic files you receive. In the event that a conflict arises between the signed contract documents prepared by FRK-AE and electronic files, the signed contract documents shall govern. You are responsible for determining if any conflict exists. By your use of these electronic files, you are not relieved of your duty to fully comply with the contract documents, including and without limitation, the need to check, confirm and coordinate all dimensions and details, take field measurements, verify field conditions and coordinate your work with that of other contractors for the project.

Because of the potential that the information presented on the electronic files can be modified, unintentionally or otherwise, FRK-AE reserves the right to remove all indicia of its ownership and/or involvement from each electronic display.
FRK-AE will furnish you electronic files of the following drawing sheets:

(List of Contractor requested sheets)

A service fee of $100.00 (one hundred dollars) per sheet shall be remitted to FRK-AE prior to delivery of electronic files.

Under no circumstances shall delivery of the electronic files for use by you be deemed a sale by FRK-AE and FRK-AE makes no warranties, either express or implied, of merchantability and fitness for any particular purpose. In no event shall FRK-AE be liable for any loss of profit or any consequential damages.

This Agreement shall be signed and attested by officers of the corporation, with appropriate title under each signature.

Architect: frk architects + engineers  Contractor: (Add Contractors name)

__________________________________________  __________________________________________
Signature                                                                 Signature

__________________________________________  __________________________________________
Printed Name & Title  Printed Name & Title

__________________________________________  __________________________________________
Date                                                                 Date
APPENDIX B

ACKNOWLEDGMENT AND CERTIFICATION

[Insert name of vendor/supplier/contractor/subcontractor] ("Company") is providing services to the Ankeny Community School District ("District"), as a vendor, supplier, contractor or subcontractor and/or is operating or managing the operations of a vendor, supplier, or contractor. The services provided by the Company may involve the presence of Company’s employees upon the real property of the schools of the District.

The Company acknowledges that the Iowa law prohibits a sex offender who has been convicted of a sex offense against a minor from being present upon the real property of the schools of the District. The Company further acknowledges that, pursuant to law, a sex offender who has been convicted of a sex offense against a minor may not operate, manage, be employed by, or act as a contractor, vendor or supplier of services or volunteer at the schools of the District.

The Company hereby certifies that no one who is an owner, operator or manager of the Company has been convicted of a sex offense against a minor. The Company further agrees that it shall not permit any person who is a sex offender convicted of a sex offense against a minor to provide any services to the District in accordance with the prohibitions set forth above.

This Acknowledgment and Certification is to be construed under the laws of the State of Iowa. If any portion hereof is held invalid, the balance of the document shall, notwithstanding, continue in full legal force and effect.

In signing this Acknowledgment and Certification, the person signing on behalf of the Company hereby acknowledges that he/she has read this entire document, that he/she understands its terms, and that he/she not only has the authority to sign the document on behalf of the Company, but has signed it knowingly and voluntarily.

Date: ____________________________

By: _______________________________

[insert name of contractor or subcontractor]

Name: _____________________________

Title: ______________________________
A. The Contractor shall purchase and maintain such insurance as will protect the Contractor from claims set forth below which may arise out of, or result from the Contractor’s operations under the contract, whether such operation be by the Contractor or by any subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable. The insurance to be maintained by the Contractor shall be written as follows:

1. **Workers’ Compensation and Employers Liability Insurance** as prescribed by Iowa law or the minimum limits shown below;
   a. Iowa Benefits-Statutory
   b. Employers Liability
      - Bodily Injury by Accident: $500,000 Each Accident
      - Bodily Injury by Disease: $500,000 Each Accident
      - Bodily Injury by Disease: $500,000 Each Employee

   The Workers’ Compensation policy shall include a *waiver of subrogation clause* in favor of the owner.

2. **Commercial General Liability Insurance** combined single limits shown below covering Bodily Injury, Property Damage and Personal Injury:
   - General Aggregate Limit: $2,000,000
   - Products-Completed Operations Aggregate Limit: $2,000,000
   - Personal & Advertising Injury Limit: $1,000,000
   - Each Occurrence Limit: $1,000,000
   - Fire Damage Limit (for any one fire): $100,000
   - Medical Damage Limit (any one person): $5,000

   This insurance must include the following features:
   a. Coverage for all premises and operations. The policy shall be endorsed to provide the aggregate Per Project Endorsement.
   b. Personal and Advertising Injury
   c. Operations by independent contractors.
   d. Contractual Liability coverage
   e. Coverage for property damage underground or damage by explosion or collapse (XCU).
3. **Automobile Liability Insurance** covering all owned, non-owned, hired and leased vehicles with a minimum combined single limit for Bodily Injury and Property Damage of $1,000,000 per accident. Insurance must include Contractual Liability.

4. **Umbrella/Excess Liability Insurance** combined single limit for bodily injury, property damage and personal injury excess primary liability limits: $1,000,000.

5. **Additional Insured** The Contractor will include the School as additional Insured on all policies except Workers’ Compensation as respects all work performed.

6. **Insurance Certificates** Each policy noted above shall be issued by an insurance company authorized to write such insurance in the State of Iowa and shall be reasonably acceptable to the School. These insurance policies shall not be cancelled without at least 30 days prior written notice to the School. A properly executed Certificate of Insurance showing evidence of these insurance requirements shall be delivered to the School prior to the commencement of this lease.

7. **Government Immunity** The following clauses will be added to all liability coverages:

   a. The company and the insured expressly agree and state that the purchase of this policy of insurance by the insured does not waive any of the defenses of governmental immunity available to the insured under Iowa Code Section 670.4 as it now exists and as it may be amended from time to time.

   b. The company and the insured further agree that this policy of insurance shall cover only those claims not subject to the defense of governmental immunity under Iowa Code Section 670.4 as it now exists and as it may be amended from time to time.

8. **Subrogation** To the extent that such insurance is in force and collectible and to the extent permitted by law, the School and Contractor each hereby releases and waives all right of recovery against the other or anyone claiming through or under each of them by way of subrogation or otherwise. The forgoing release and waiver shall apply to damage to contractor’s equipment, tools and other personal property as well as automobiles.
9. **Property Insurance** Unless otherwise provided, the Owner shall purchase and maintain property insurance on the project in the amount of the initial Contract Sum, plus value of subsequent Contract modifications and cost of materials supplied or installed by others. Such property insurance shall be maintained, unless otherwise provided in the Contract Documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made. This insurance shall include interests of the Owner, the Contractor, Subcontractors and Sub-subcontractors in the Project.

Property insurance shall be on an “all-risk” or equivalent policy form and shall include insurance against the perils of fire, theft, vandalism, malicious mischief, collapse, earthquake, flood, windstorm, testing and debris removal including demolition occasioned by enforcement of any applicable legal requirements. The property insurance shall contain sub-limits of $1,000,000 per occurrence for earthquake and $1,000,000 per occurrence for flood. At the option of the school district, the insurance covering the project may be written under a Builder’s Risk policy or covered under the District’s permanent property insurance.
SECTION 01 11 00
SUMMARY OF WORK

1. PART 1  GENERAL

1.1 SUMMARY

A. Section Includes:
   2. Work by Owner.
   3. Owner supplied products.
   4. Contractor use of site and premises.
   5. Work sequence.
   6. Owner occupancy.
   7. Specification Conventions.

1.2 CONTRACT DESCRIPTION

A. Perform Work of Contract under stipulated sum contract with Owner in accordance with Conditions of Contract.

1.3 WORK BY OWNER

A. Items noted NIC (Not in Contract), movable cabinets, furnishings, and minor equipment will be furnished and installed by Owner beginning after Substantial Completion.

1.4 OWNER SUPPLIED PRODUCTS

A. Owner's Responsibilities:
   1. Arrange for and deliver Owner-reviewed Shop Drawings, Product Data, and Samples, to Contractor.
   2. Arrange and pay for delivery to site.
   3. On delivery, inspect products jointly with Contractor.
   4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
   5. Arrange for manufacturers' warranties, inspections, and service.
B. Contractor's Responsibilities:
   1. Review Owner-reviewed Shop Drawings, Product Data, and Samples.
   2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
   3. Handle, store, install and finish Products.
   4. Repair or replace items damaged after receipt.

C. Items supplied by Owner for installation by Contractor:
   1. Toilet tissue dispensers.
   2. Paper towel dispensers.
   3. Soap dispensers.

1.5 CONTRACTOR’S USE OF SITE AND PREMISES

A. Limit use of site and premises to allow:
   1. Owner occupancy.
   2. Work by Owner.

B. Construction Operations: Limited to areas noted on Drawings.

C. Emergency Building Exits During Construction: Existing exits to remain open and accessible during construction period; provide protection when required.

D. Service Access During Construction: Existing drives, parking areas, and trash collection facilities to remain open and accessible during construction period.

E. Utility Outages and Shutdown: Existing utilities to remain in service during construction period. Outages and shutdowns to be scheduled with Owner 48 hours in advance.

1.6 WORK SEQUENCE

A. Construct Work to accommodate Owner's occupancy requirements during the construction period, coordinate construction schedule and operations with Owner and Architect/Engineer:
   1. Work may be started on or after the 1st day of June, 2020 following Owner receipt and approval of required Bonds and Insurance.
   2. Work shall be Substantially Complete on or before the 21st day of August, 2020.
1.7 OWNER OCCUPANCY

A. The Owner will occupy the site and premises during the entire period of construction.

B. Cooperate with Owner to minimize conflict, and to facilitate Owner's operations.

C. Schedule the Work to accommodate Owner occupancy.

1.8 SPECIFICATION CONVENTIONS

A. These specifications are written in imperative mood and streamlined form. This imperative language is directed to the Contractor, unless specifically noted otherwise. The words “shall be” are included by reference where a colon (:) is used within sentences or phrases.

2. PART 2 PRODUCTS

Not Used.

3. PART 3 EXECUTION

Not Used.

END OF SECTION
SECTION 01 20 00

PRICE AND PAYMENT PROCEDURES

1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Contingency allowances.
   2. Schedule of values.
   3. Applications for payment.
   5. Defect assessment.

1.2 CONTINGENCY ALLOWANCE

A. Include in the Contract, a stipulated sum/price for use upon Owner’s instructions in amount of $75,000.

B. Contractor’s costs for products, delivery, installation, labor, insurance, payroll, taxes, equipment rental, overhead and profit will be included in Change Orders authorizing expenditure of funds from this Contingency Allowance.

C. Funds will be drawn from the Contingency Allowance only by Change Order.

D. At closeout of Contract, funds remaining in Contingency Allowance will be credited to Owner by Change Order.

1.3 SCHEDULE OF VALUES


B. Submit Schedule of Values in duplicate within 15 days after date of Owner-Contractor Agreement.

C. Format: Utilize Table of Contents of this Project Manual. Identify each line item with number and title of major specification Section. Identify site mobilization, bonds, and insurance.
D. Include in separate line item for Contingency Allowance specified in this section.

E. Include separately from each line item, direct proportional amount of Contractor’s labor.

F. Revise schedule to list approved Change Orders, with each Application for Payment.

1.4 APPLICATIONS FOR PAYMENT


B. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.

C. Submit updated construction schedule with each Application for Payment.

D. Payment Period: Submit at intervals stipulated in Agreement.

E. Submit with transmittal letter as specified for Submittals in Section 01 33 00 - Submittal Procedures.

F. Substantiating Data: When Architect/Engineer requires substantiating information, submit data justifying dollar amounts in question. Include the following with Application for Payment:
   1. Affidavits attesting to off-site stored products, including accompanying insurance certificates covering stored products.
   2. Construction progress schedules, revised and current as specified in Section 01 33 00.

1.5 CHANGE PROCEDURES

A. Submittals: Submit name of individual authorized to receive change documents, and be responsible for informing others in Contractor’s employ or Subcontractors of changes to the Work.

B. The Architect/Engineer will advise of minor changes in the Work not involving adjustment to Contract Sum/Price or Contract Time by issuing supplemental instructions.
C. The Architect/Engineer may issue a Proposal Request including a
detailed description of proposed change with supplementary or
revised Drawings and specifications. Contractor will prepare and
submit estimate within 10 days.

D. Contractor may propose changes by submitting a request for
change to Architect/Engineer, describing proposed change and its
full effect on the Work. Include a statement describing reason for
the change, and effect on Contract Sum/Price and Contract Time
with full documentation.

E. Stipulated Sum/Price Change Order: Based on Proposal Request
and Contractor’s fixed price quotation or Contractor’s request for
Change Order as approved by Architect/Engineer.

F. Construction Change Directive: Architect/Engineer may issue
directive, on AIA Form G714-2007, Construction Change Directive
signed by Owner, instructing Contractor to proceed with changes in
the Work, for subsequent inclusion in a Change Order. Document
will describe changes in the Work and designate method of
determining any change in Contract Sum/Price or Contract Time.
Promptly execute change.

G. Document each quotation for change in cost or time with sufficient
data to allow evaluation of quotation.


I. Execution of Change Orders: Architect/Engineer will issue Change
Orders for signatures of parties as provided in Conditions of the
Contract.

J. Correlation of Contract Submittals:
   1. Promptly revise Schedule of Values and Application for
      Payment forms to record each authorized Change Order as
      separate line item and adjust Contract Sum/Price.
   2. Promptly revise progress schedules to reflect change in
      Contract Time, revise sub-schedules to adjust times for
      other items of work affected by the change, and resubmit.
   3. Promptly enter changes in Project Record Documents.
1.6 DEFECT ASSESSMENT

A. Replace the Work, or portions of the Work, not conforming to specified requirements.

B. If, in the opinion of the Architect/Engineer, it is not practical to remove and replace the Work, the Architect/Engineer will direct appropriate remedy or adjust payment.

C. The defective Work may remain, but unit sum/price will be adjusted to new sum/price at discretion of the Architect/Engineer.

D. Defective Work may be partially repaired to instructions of Architect/Engineer, and unit sum/price will be adjusted to new sum/price at discretion of Architect/Engineer.

E. Individual specification sections may modify these options or may identify specific formula or percentage sum/price reduction.

F. Authority of Architect/Engineer to assess defects and identify payment adjustments, is final.

G. Non-Payment For Rejected Products: Payment will not be made for rejected products for any of the following:
   1. Products wasted or disposed of in a manner that is not acceptable.
   2. Products determined as unacceptable before or after placement.
   3. Products not completely unloaded from transporting vehicle.
   4. Products placed beyond lines and levels of required Work.
   5. Products remaining on hand after completion of the Work.
   6. Loading, hauling, and disposing or rejected products.

2. PART 2 PRODUCTS
   Not Used.

3. PART 3 EXECUTION
   Not Used.

END OF SECTION
SECTION 01 30 00
ADMINISTRATIVE REQUIREMENTS

1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Coordination and project conditions.
   2. Preconstruction meeting.
   3. Site mobilization meeting.
   4. Progress meetings.
   5. Pre-installation meetings.
   6. Cutting and patching.
   7. Special procedures.

1.2 COORDINATION AND PROJECT CONDITIONS

A. Coordinate scheduling, submittals, and Work of various sections of Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

B. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, operating equipment.

C. Coordinate space requirements, supports, and installation of mechanical and electrical Work indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

D. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within construction. Coordinate locations of fixtures and outlets with finish elements.

E. Coordinate completion and clean-up of Work of separate sections in preparation for Substantial Completion.
F. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.3 PRECONSTRUCTION MEETING

A. Architect/Engineer will schedule meeting after Owner-Contractor Agreement Execution.

B. Attendance Required: Owner, Architect/Engineer, and Contractor.

C. Agenda:
   1. Distribution of Contract Documents.
   2. Submission of list of Subcontractors, list of products, schedule of values, and progress schedule.
   4. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
   5. Scheduling.

D. Architect/Engineer will record minutes and distribute copies to participants, with one copy to Owner and Contractor. Contractor shall distribute copies to those affected by decisions made.

1.4 SITE MOBILIZATION MEETING

A. Architect/Engineer will schedule meeting at Project site prior to Contractor occupancy.

B. Attendance Required: Owner, Architect/Engineer, Special Consultants, Contractor, Contractor's Superintendent, and major Subcontractors.

C. Agenda:
   1. Use of premises by Owner and Contractor.
   2. Owner's requirements and occupancy.
   3. Construction facilities and controls provided by Contractor.
   4. Temporary utilities provided by Contractor.
   5. Survey and building layout.
7. Schedules.
8. Application for payment procedures.
9. Procedures for testing.
11. Requirements for start-up of equipment.
12. Inspection and acceptance of equipment put into service during construction period.

D. Architect/Engineer will record minutes and distribute copies to participants, with one copy to Owner and Contractor. Contractor will distribute copies to those affected by decisions made.

1.5 PROGRESS MEETINGS

A. Architect/Engineer will schedule and administer meetings throughout progress of the Work at maximum monthly intervals.

B. Architect/Engineer will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

C. Attendance Required: Job superintendent, major subcontractors and suppliers, Owner, Architect/Engineer, as appropriate to agenda topics for each meeting.

D. Agenda:
1. Review minutes of previous meetings.
2. Review of Work progress.
3. Field observations, problems, and decisions.
4. Identification of problems which impede planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of off-site fabrication and delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on progress schedule and coordination.
13. Other business relating to Work.

E. Architect/Engineer will record minutes and distribute copies to participants, with one copy to Owner and Contractor. Contractor will distribute copies to those affected by decisions made.
1.6 PREINSTALLATION MEETING

A. When required in individual specification sections, convene pre-installation meeting at Project site prior to commencing work of specific section.

B. Require attendance of parties directly affecting, or affected by, Work of specific section.

C. Notify Architect/Engineer four days in advance of meeting date.

D. Prepare agenda and preside at meeting:
   1. Review conditions of installation, preparation and installation procedures.
   2. Review coordination with related work.

E. Record minutes and distribute copies within [two] seven days after meeting to participants, with one copy to Architect/Engineer, Owner, and those affected by decisions made.

2. PART 2 PRODUCTS

Not Used.

3. PART 3 EXECUTION

3.1 CUTTING AND PATCHING

A. Employ skilled and experienced installer to perform cutting and patching.

B. Submit written request in advance of cutting or altering elements affecting:
   1. Structural integrity of element.
   2. Integrity of weather-exposed or moisture-resistant elements.
   3. Efficiency, maintenance, or safety of element.
   5. Work of Owner.
C. Execute cutting, fitting, and patching including excavation and fill, to complete Work, and to:
   1. Fit the several parts together, to integrate with other Work.
   2. Uncover Work to install or correct ill-timed Work.
   3. Remove and replace defective and non-conforming Work.
   4. Remove samples of installed Work for testing.
   5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.

D. Execute Work by methods to avoid damage to other work, and to provide proper surfaces to receive patching and finishing.

E. Cut masonry and concrete materials using masonry saw or core drill.

F. Restore Work with new Products in accordance with requirements of Contract Documents.

G. Fit Work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

H. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.

I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 84 00 for general construction penetrating items and Division 21, 22, 23, 26, 27, and 28 sections for fire suppression, plumbing, HVAC, electrical, communications, and electronic safety and security penetrating items; to full thickness of penetrated element.

J. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.

K. Identify hazardous substance or condition exposed during the Work to Architect/Engineer for decision or remedy.
3.2 SPECIAL PROCEDURES

A. Materials: As specified in product sections; match existing with new products and salvaged products for patching and extending work.

B. Employ skilled and experienced installer to perform alteration work.

C. Cut, move, or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion.

D. Remove unsuitable material not marked for salvage, such as rotted wood, corroded metal, and deteriorated masonry and concrete. Replace materials as specified for finished Work.

E. Remove debris and abandoned items from area and from concealed spaces.

F. Prepare surface and remove surface finishes to permit installation of new Work and finishes.

G. Close openings in exterior surfaces to protect existing work from weather and extremes of temperature and humidity.

H. Remove, cut, and patch Work in a manner to minimize damage and to permit restoring products and finishes to original or specified condition.

I. Refinish existing visible surfaces to remain in renovated rooms and spaces, to specified condition for each material, with neat transition to adjacent finishes.

J. Where new Work abuts or aligns with existing, provide smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.

K. When finished surfaces are cut so that a smooth transition with new Work is not possible, terminate existing surface along a straight line at natural line of division and submit recommendation to Architect/Engineer for review.

L. Where change of plane of 1/4 inch or more occurs, submit recommendation for providing smooth transition; to Architect/Engineer for review.
M. Trim existing doors to clear new floor finish. Refinish trim to specified condition.

N. Patch or replace portions of existing surfaces which are damaged, lifted, discolored, or showing other imperfections.

O. Finish surfaces as specified in individual product sections.

END OF SECTION
SECTION 01 33 00

SUBMITTAL PROCEDURES

1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Submittal procedures.
   2. Construction progress schedules.
   3. Proposed products list.
   4. Product data.
   5. Shop drawings.
   6. Samples.
   7. Design data.
   8. Test reports.
   9. Certificates.
   10. Manufacturer’s instructions.
   11. Manufacturer’s field reports.

1.2 SUBMITTAL PROCEDURES

A. Transmit each submittal with Architect/Engineer accepted form.

B. Sequentially number transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix.

C. Identify Project, Contractor, subcontractor and supplier; pertinent drawing and detail number, and specification section number, appropriate to submittal.

D. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents.

E. Schedule submittals to expedite Project, and transmit to Submittal Exchange. Coordinate submission of related items.
F. Identify variations from Contract Documents and product or system limitations which may be detrimental to successful performance of completed Work.

G. Allow space on submittals for Contractor and Architect/Engineer review stamps.

H. When revised for resubmission, identify changes made since previous submission.

I. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.

J. Submittals not requested will not be recognized or processed.

1.3 CONSTRUCTION PROGRESS SCHEDULES

A. Submit 4 copies of initial schedules within 30 days after date of Owner-Contractor Agreement. After review, resubmit required revised data within 10 days.

B. Submit revised Progress Schedules with each Application for Payment.

C. Distribute copies of reviewed schedules to Project site file, subcontractors, suppliers, and other concerned parties.

D. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

E. Submit computer generated horizontal bar chart with separate line for each major portion of Work or operation, identifying first work day of each week.

F. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate early and late start, early and late finish, float dates, and duration.

G. Indicate estimated percentage of completion for each item of Work at each submission.
H. Submit separate schedule of submittal dates for shop drawings, product data, and samples, including Owner furnished products, and dates reviewed submittals will be required from Architect/Engineer. Indicate decision dates for selection of finishes.

I. Indicate delivery dates for Owner furnished products.

J. Revisions to Schedules:
   1. Indicate progress of each activity to date of submittal, and projected completion date of each activity.
   2. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes.
   3. Prepare narrative report to define problem areas, anticipated delays, and impact on Schedule. Report corrective action taken, or proposed, and its effect.

K. Schedule shall include signature of Contractor.

1.4 PROPOSED PRODUCTS LIST

A. Within 30 days after date of Owner-Contractor Agreement, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards. No product shall be used in Work without Architect/Engineer's written acceptance.

1.5 PRODUCT DATA

A. Product Data: Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

B. Submittal Requirements: Submittals to be submitted in accordance with ELECTRONIC SUBMITTAL PROCEDURES article.

C. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information unique to this Project.
D. Indicate Product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

E. After review, distribute in accordance with ELECTRONIC SUBMITTAL PROCEDURES article and for record documents described in Section 01 70 00 - Execution and Closeout Requirements.

1.6 SHOP DRAWINGS

A. Shop Drawings: Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in the Contract Documents.

B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. When required by individual specification sections, provide shop drawings signed and sealed by professional engineer responsible for designing components shown on shop drawings.
   1. Include signed and sealed calculations to support design.
   2. Submit drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.
   3. Make revisions and provide additional information when required by authorities having jurisdiction.

D. Submittal Requirements: Submittals to be submitted in accordance with ELECTRONIC SUBMITTAL PROCEDURES article.

E. Shop Drawings shall be prepared for Work of this Contract. Drawings prepared for other Contracts and revised for this Contract or annotated photocopy reproductions of Architect/Engineers Contract Document Drawings will be rejected.

F. Shop Drawings shall be based upon actual measurements taken at Project site where possible. Contractor shall show any variations and revisions to Contract Documents necessary for proper installation.
G. After review, distribute in accordance with ELECTRONIC SUBMITTAL PROCEDURES article and for record documents described in Section 01 70 00 - Execution and Closeout Requirements.

1.7 SAMPLES

A. Samples: Submitted to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

B. Samples for Selection as Specified in Product Sections:
   1. Submitted to Architect/Engineer for aesthetic, color, or finish selection.
   2. Submit samples of finishes from full range of manufacturer's standard or custom colors, textures, and patterns for Architect/Engineer selection.

C. Submit samples to illustrate functional and aesthetic characteristics of Products, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

D. Include identification on each sample, with full Project information.

E. Submit number of samples specified in individual specification sections; Architect/Engineer will retain one sample.

F. Reviewed samples which may be used in Work are indicated in individual specification sections.

G. Samples will not be used for testing purposes unless specifically stated in specification section.

H. After review, distribute in accordance with ELECTRONIC SUBMITTAL PROCEDURES article and for record documents described in Section 01 70 00 - Execution and Closeout Requirements.

1.8 DESIGN DATA

A. Submit for Architect/Engineer's knowledge as contract administrator or for Owner.
B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.9 TEST REPORTS

A. Submit for Architect/Engineer's knowledge as contract administrator or for Owner.

B. Submit test reports for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.10 CERTIFICATES

A. When specified in individual specification sections, submit certification by manufacturer, installation/application subcontractor, or Contractor to Architect/Engineer, in quantities specified for Product Data.

B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or Product, but must be acceptable to Architect/Engineer.

1.11 MANUFACTURER'S INSTRUCTIONS

A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to Architect/Engineer for delivery to Owner in quantities specified for Product Data.

B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.12 MANUFACTURER'S FIELD REPORTS

A. Submit reports for Architect/Engineer's benefit as contract administrator or for Owner.
B. Submit report in duplicate within 5 days of observation to Architect/Engineer for information.

C. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.13 ERECTION DRAWINGS

A. Submit drawings for Architect/Engineer's benefit as contract administrator or for Owner.

B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

C. Data indicating inappropriate or unacceptable Work may be subject to action by the Architect/Engineer or Owner.

1.14 ELECTRONIC SUBMITTAL PROCEDURES

A. Summary:
   1. Shop drawing and product data submittals shall be transmitted to Architect/Engineer in electronic (PDF) format using Submittal Exchange, a website service designed specifically for transmitting submittals between construction team members.
   2. The intent of electronic submittals is to expedite the construction process by reducing paperwork, improving information flow, and decreasing turnaround time.
   3. The electronic submittal process is not intended for color samples, color charts, or physical material samples.

B. Procedures:
   1. Submittal Preparation - Contractor may use any or all of the following options:
      a. Subcontractors and Suppliers provide electronic (PDF) submittals to Contractor via the Submittal Exchange website.
      b. Subcontractors and Suppliers provide paper submittals to Contractors who electronically scans and converts to PDF format.
c. Subcontractors and Suppliers provide paper submittals to Scanning Service which electronically scans and converts to PDF format.

2. Contractors shall review and apply electronic stamp certifying that the submittal complies with the requirements of the Contract Documents including verification of manufacturer / product, dimensions and coordination of information with other parts of the work.


4. Architect/Engineer and Consultant review comments will be made available on the Submittal Exchange website for downloading. Contractors will receive email notice of completed review.

5. Distribution of reviewed submittals to subcontractors and suppliers is the responsibility of the Contractor.

6. Submit paper copies of reviewed submittals at project closeout for record purposes in accordance with Section 01 70 00 - Execution and Closeout Requirements.

C. Costs:

1. Owner will contract with Submittal Exchange, and will pay costs associated with use of site for this Project.

2. Training is available from Submittal Exchange regarding use of website and PDF submittals. Cost of training will also be paid for by Construction Manager.

3. Internet Service and Equipment Requirements:
   a. Email address and Internet access at Contractor’s main office.
   b. Adobe Acrobat (www.adobe.com), Bluebeam PDF Revu (www.bluebeam.com), or other similar PDF review software for applying electronic stamps and comments.

2. PART 2 PRODUCTS

   Not Used
3. PART 3 EXECUTION

3.1 SCHEDULE

A. Shop drawings, product data, samples, manufacturer's installation instructions, and manufacturer's certificates shall be submitted for, but not limited to, the items listed in each Section of Specifications.

END OF SECTION
SECTION 01 40 00

QUALITY REQUIREMENTS

1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Quality control and control of installation.
   2. Tolerances.
   3. References.
   4. Mockup requirements.
   5. Testing and inspection services.
   6. Manufacturers' field services.
   7. Examination.
   8. Preparation.

1.2 QUALITY CONTROL AND CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. When manufacturers' instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform Work by persons qualified to produce required and specified quality.

F. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.
G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.3 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to product acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.

C. Adjust products to appropriate dimensions; position before securing Products in place.

1.4 REFERENCES

A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on date of Contract Documents, except where specific date is established by code.

C. Obtain copies of standards where required by product specification sections.

D. Neither contractual relationship, duties, nor responsibilities of parties in Contract nor those of Architect/Engineer shall be altered from Contract Documents by mention or inference otherwise in reference document.

1.5 MOCKUP REQUIREMENTS

A. Tests will be performed under provisions identified in this section and identified in respective product specification sections.

B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
C. Accepted mockups shall be comparison standard for remaining work.

D. Where mockup has been accepted by Architect/Engineer and is specified in product specification sections to be removed; remove mockup and clear area when directed to do so by Architect/Engineer.

### 1.6 TESTING AND INSPECTION SERVICES

A. Owner will employ and pay for services of an independent firm to perform testing and inspection Scheduled at end of Section.

B. Contractor shall employ and pay for services of an independent testing agency or laboratory acceptable to perform testing Scheduled at end of Section.
   1. Prior to start of Work, submit testing laboratory name, address, and telephone number, and names of full time registered Engineer and responsible officer.
   2. Submit copy of report of laboratory facilities inspection made by Materials Reference Laboratory of National Bureau of Standards during most recent inspection, with memorandum of remedies of deficiencies reported by inspection.

C. The independent firm will perform tests, inspections, and other services specified in individual specification Sections and as required by the Architect/Engineer.
   1. Laboratory: Authorized to operate at Project location.
   2. Laboratory Staff: Maintain full time registered Engineer on staff to review services.
   3. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to National Bureau of Standards or accepted values of natural physical constants.

D. Testing, inspections and source quality control may occur on or off Project site. Perform off-site testing as required by Architect/Engineer or the Owner.

E. Reports will be submitted by independent firm to Architect/Engineer and Contractor, in duplicate, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
F. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
   1. Notify Architect/Engineer and independent firm 24 hours prior to expected time for operations requiring services.
   2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.

G. Testing, inspecting, and employment of testing and inspecting agency shall not relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

H. Re-testing or re-inspection required because of non-conformance to specified requirements shall be performed by same independent firm on instructions by Architect/Engineer. Payment for re-testing or re-inspection will be charged to Contractor by deducting testing or inspecting charges from Contract Sum/Price.

I. Agency Responsibilities:
   1. Test samples of mixes submitted by Contractor.
   3. Perform specified sampling and testing of products in accordance with specified standards.
   4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   5. Promptly notify Architect/Engineer and Contractor of observed irregularities or non-conformance of Work or products.
   6. Perform additional tests required by Architect/Engineer.
   7. Attend preconstruction meetings and progress meetings.

J. Agency Reports: After each test, promptly submit two copies of report to Architect/Engineer and to Contractor. When requested by Architect/Engineer, provide interpretation of test results. Include the following:
   1. Date issued.
   2. Project title and number.
   3. Name of inspector.
   4. Date and time of sampling or inspection.
   5. Identification of product and specifications section.
   6. Location in Project.
   7. Type of inspection or test.
   8. Date of test.
9. Results of tests.

K. Limits of Testing Authority:
   1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency or laboratory may not approve or accept any portion of the Work.
   3. Agency or laboratory may not assume any duties of Contractor.
   4. Agency or laboratory has no authority to stop the Work.

1.7 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as applicable, and to initiate instructions when necessary.

B. Submit qualifications of observer to Architect/Engineer 30 days in advance of required observations. Observer subject to approval of Architect/Engineer and Owner.

C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers’ written instructions.

D. Refer to Section 01 33 00 - Submittal Procedures, MANUFACTURERS' FIELD REPORTS article.

2. PART 2 PRODUCTS

Not Used.
3. PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.

B. Verify existing substrate is capable of structural support or attachment of new Work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Verify utility services are available, of correct characteristics, and in correct locations.

3.2 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.3 SCHEDULE

A. Special Inspections paid for by Owner and performed by Owner's independent firm; requirements and standards as indicated on Drawings and in individual specifications sections.
   1. Structural Special Inspections: Requirements and standards as indicated on Drawings and in individual specifications.

B. Tests and Inspections other than those indicated above shall be paid for by Contractor and performed by Contractor's independent firm; requirements and standards as indicated in individual specification sections.

END OF SECTION
SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Temporary Utilities:
      a. Temporary electricity.
      b. Temporary lighting for construction purposes.
      c. Temporary ventilation.
      d. Telephone service.
      e. Temporary water service.
      f. Temporary sanitary facilities.
   2. Construction Facilities:
      a. Storage sheds.
      b. Vehicular access.
      c. Parking.
      d. Progress cleaning and waste removal.
      e. Scaffolding and ladders.
      f. Lifts and hoists.
      g. Fire prevention facilities.
   3. Temporary Controls:
      a. Fencing.
      c. Pollution control.
   4. Removal or utilities, facilities, and controls.

1.2 TEMPORARY ELECTRICITY

A. Connect to Owner's existing power service. Do not disrupt Owner's use of service. Owner will pay cost of energy used. Exercise measures to conserve energy.

B. Complement existing power service capacity and characteristics as required for construction operations.

C. Provide flexible power cords as required for portable construction tools and equipment.
D. Permanent convenience receptacles may be utilized during construction.

1.3 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

A. Provide and maintain incandescent lighting for construction operations to achieve minimum lighting level of 2 watt/sq ft.

B. Provide and maintain 1 watt/sq ft lighting to exterior staging and storage areas after dark for security purposes.

C. Provide and maintain 0.25 watt/sq ft HID lighting to interior work areas after dark for security purposes.

D. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps for specified lighting levels.

E. Maintain lighting and provide routine repairs.

F. Permanent building lighting may be utilized during construction.

1.4 TEMPORARY VENTILATION

A. Utilize Owner's existing ventilation equipment, extend and supplement with temporary fan units as required to maintain clean air for construction operations. Owner will pay cost of energy used. Exercise measures to conserve energy.

1.5 TELEPHONE SERVICE

A. Provide, maintain, and pay for mobile telephone service at time of project mobilization.

1.6 TEMPORARY WATER SERVICE

A. Connect to Owner's existing water source. Owner will pay cost of water used. Exercise measures to conserve water.

B. Provide flexible hoses with threaded connections as required.
1.7 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.

B. Existing facility use is not permitted.

C. At end of construction, remove facilities, disinfect area, and leave area in same or better condition than originally found.

1.8 STORAGE SHEDS

A. Do not use existing facilities for field offices or for storage.

B. Locate sheds minimum distance of 30 feet from existing structures.

C. Construction: Portable or mobile buildings, or buildings constructed with floors raised above ground.
   1. Construction: Structurally sound, secure, weather tight enclosures for office and storage spaces. Maintain during progress of Work; remove when no longer needed.
   2. Temperature Transmission Resistance of Floors, Walls, and Ceilings: Compatible with storage requirements.
   3. Exterior Materials: Weather resistant, finished in one color acceptable to Owner.
   4. Interior Materials in Storage Sheds: As required to provide specified conditions for storage of products.

D. Environmental Controls:
   1. Storage Spaces: Heating and ventilation as needed to maintain products in accordance with Contract Documents; lighting for maintenance and inspection of Products.

E. Storage Areas and Sheds: Size to storage requirements for products of individual Sections, allowing for access and orderly provision for maintenance and for inspection of products to requirements of Section 01 60 00 - Product Requirements.

F. Maintenance and Cleaning:
   1. Periodic cleaning and maintenance of storage areas.
   2. Maintain approach walks free of mud, water, and snow.

G. Removal: At completion of Work remove debris. Restore areas.
1.9 VEHICULAR ACCESS

A. Use designated existing on-site roads for construction traffic.

B. Location as approved by Owner.

C. Provide unimpeded access for emergency vehicles. Maintain 20 foot wide driveways with turning spaces between and around combustible materials.

D. Provide and maintain access to fire hydrants [and control valves] free of obstructions.

1.10 PARKING

A. Use of designated areas of existing parking facilities used by construction personnel is permitted.

B. Location as approved by Owner.

C. When site space is not adequate, provide additional off-site parking.

D. Maintenance:
   1. Maintain traffic and parking areas in sound condition free of excavated material, construction equipment, products, mud, snow, and ice.
   2. Maintain existing paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original condition.

1.11 PROGRESS CLEANING AND WASTE REMOVAL

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, and other closed or remote spaces, prior to enclosing spaces.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
D. Collect and remove waste materials, debris, and rubbish from site periodically and dispose off-site.

1.12 FIRE PREVENTION FACILITIES

A. Owner’s premises and site are designated ‘No Smoking’. Under State law, smoking is prohibited within buildings under construction or renovation, and on site.

B. Establish fire watch for cutting and welding and other hazardous operations capable of starting fires. Maintain fire watch before, during, and after hazardous operations until threat of fire does not exist.

C. Portable Fire Extinguishers: NFPA 10; 10 pound capacity, 4A-60B: C UL rating.
   1. Provide one fire extinguisher at each construction entrance to buildings [and at entrances to stairways on each floor of buildings under renovation].
   2. Provide minimum one fire extinguisher in every storage shed.
   3. Provide minimum one fire extinguisher on roof during operations using heat producing equipment.

1.13 SCAFFOLDING AND LADDERS

A. Provide and maintain scaffolding and ladders for construction operations. Conform to regulations of authority having jurisdiction.

B. Removal: At completion of Work remove scaffolding and ladders.

1.14 LIFTS AND HOISTS

A. Motorized personnel lift and construction material hoist use on elevated floor slabs shall be limited to the following:
   1. Combined Weight: Weight of lift and personnel, and hoist, personnel, and materials shall not exceed 3,200 pounds.

1.15 FENCING

A. Construction: Commercial grade chain link fence.
B. Provide 6 foot high fence around site staging and storage areas; equip with vehicular and pedestrian gates with locks, and non-penetrating bases.

1.16 SECURITY

A. Security Program:
   1. Protect Work, existing premises, and Owner’s operations from theft, vandalism, and unauthorized entry.
   2. Initiate program in coordination with Owner’s existing security system at project mobilization.
   3. Maintain program throughout construction period until Owner occupancy.

B. Entry Control:
   1. Restrict entrance of persons and vehicles into Project site and existing facilities.
   2. Allow entrance only to authorized persons with proper identification.
   3. Maintain log of workers and visitors, make available to Owner on request.
   4. Owner will control entrance of persons and vehicles related to Owner’s operations.

C. Personnel Identification:
   1. Provide identification badge to each person authorized to enter premises.
   2. Badge to Include: Personal photograph and name, and employers name and telephone number.
   3. Maintain list of accredited persons, submit copy to Owner on request.
   4. Require return on badges at expiration of their employment on the Work.

D. Restrictions:
   1. Do not allow cameras on site or photographs taken except by written approval of Owner.

1.17 DUST CONTROL

A. Execute Work by methods to minimize raising dust from construction operations.
B. Provide positive means to prevent air-borne dust from dispersing into atmosphere.

1.18 POLLUTION CONTROL

A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.

B. Comply with pollution and environmental control requirements of authorities having jurisdiction.

1.19 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, and materials, prior to Substantial Completion inspection.

B. Clean and repair damage caused by installation or use of temporary work.

C. Restore existing and permanent facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

D. Patch, repair, or replace publicly-owned structures and facilities damaged or removed as a result of new Work as required by governing authorities.

2. PART 2 PRODUCTS

Not Used.

3. PART 3 EXECUTION

Not Used.

END OF SECTION
SECTION 01 60 00

PRODUCT REQUIREMENTS

1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Products.
   2. Product delivery requirements.
   3. Product storage and handling requirements.
   4. Product options.
   5. Product substitution procedures.

1.2 PRODUCTS

A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.

B. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.

C. Furnish interchangeable components from same manufacturer for components being replaced.

1.3 PRODUCT DELIVERY REQUIREMENTS

A. Transport and handle products in accordance with manufacturer's instructions.

B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.

C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

A. Store and protect products in accordance with manufacturer's instructions.
B. Store with seals and labels intact and legible.

C. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.

D. For exterior storage of fabricated products, place on sloped supports above ground.

E. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.

F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

G. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

H. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

I. Arrange storage of products to permit access for inspection. Periodically inspect to verify Products are undamaged and are maintained under acceptable conditions.

1.5 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Products complying with specified reference standards of description.

B. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit request for Substitution for any manufacturer not named, in accordance with ‘Product Substitution Procedures’ article below.

C. Products Specified by Naming Product of Reference Manufacturer with Other Acceptable Manufacturers Listed with Provision for Substitutions: Product of listed Acceptable Manufacturer meeting minimum attributes of Reference Manufacturer such as profile, material thickness, finish, available color selections, options, etc. Submit request for Substitution for any manufacturer not named in accordance with the ‘Product Substitution Procedures’ article below.
1.6 PRODUCT SUBSTITUTION PROCEDURES

A. Instructions to Bidders specify time restrictions for submitting requests for Substitutions during bidding period to requirements specified in this section.

B. Substitutions may be considered during the construction period only when a product becomes unavailable through no fault of Contractor.

C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

D. A request constitutes a representation that Bidder:
   1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
   2. Will provide same warranty for Substitution as for specified product.
   3. Will coordinate installation and make changes to other Work which may be required for Work to be complete with no additional cost to Owner.
   4. Waives claims for additional costs or time extension which may subsequently become apparent.
   5. Will reimburse Owner and Architect/Engineer for review or redesign services associated with re-approval by authorities having jurisdiction.

E. Substitutions will not be considered when they are indicated or implied on Shop Drawings or Product Data submittals, without separate written request.

2. PART 2 PRODUCTS

Not Used.

3. PART 3 EXECUTION

Not Used.

END OF SECTION
SUBSTITUTION REQUEST FORM  
(During Bidding Phase)

To:  (General Construction)  
frk architects + engineers  
2600 Westown Parkway, Suite 340  
West Des Moines, IA 50266  
Phone: 515-223-5100  
Fax: 515-223-7226  

(OR)  
(M/E Construction)  
KCL ENGINEERING  
300 4th Street  
West Des Moines, IA 50265  
Phone/Fax: 515-724-7938

frk architects + engineers  
2600 Westown Parkway, Suite 340  
West Des Moines, IA 50266  
Phone: 515-223-5100  
Fax: 515-223-7226

Project: Parkview Middle School, Renovation & System Upgrades - Phase 2; Ankeny, IA.  

Specification Title: __________________________ Description: __________________________

Section: __________________________ Page: __________________________ Article/Paragraph: __________________________

Proposed Substitution: ________________________________________________________________

Manufacturer: __________________________ Phone: __________________________

Trade Name: __________________________ Model No: __________________________

Attached data also includes product description, specifications, drawings, photographs, and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

The Undersigned certifies:

• Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
• Same warranty will be furnished for proposed substitution as for specified product.
• Same maintenance service and source of replacement parts, as applicable, is available.
• Proposed substitution will have no adverse effect on other trades and will not effect of delay progress schedule.
• Proposed substitution does not effect dimensions and functional clearances.
• Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by substitution.

Submitted by: __________________________

Signed by: __________________________

Firm: __________________________

Address: __________________________

Telephone: __________________________ FAX: __________________________

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

Parkview MS/FRK-1023F01 ©2020 Product Requirements
Renovation & System Upgrades - Phase 2
1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Closeout procedures.
   2. Final cleaning.
   3. Starting of systems.
   4. Demonstration and instructions.
   5. Testing, adjusting and balancing.
   6. Protecting installed construction.
   7. Project record documents.
   8. Operation and maintenance data.
   9. Spare parts and maintenance Products.
   11. Maintenance service.

1.2 CLOSEOUT PROCEDURES

A. Submit closeout documentation listed in individual specification sections of Project Manual and Scheduled at end of section.

B. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Architect/Engineer's review.

C. Provide submittals to Owner required by authorities having jurisdiction.

D. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

E. Owner will occupy portions of building as specified in Section 01 11 00 - Summary of Work.
1.3 FINAL CLEANING

A. Execute final cleaning prior to final project assessment.

B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

C. Clean equipment and fixtures to sanitary condition with cleaning materials appropriate to surface and material being cleaned.

D. Replace filters of operating equipment.

E. Clean debris from roofs and drainage systems.

F. Clean site; sweep paved areas, rake clean landscaped surfaces.

G. Remove waste and surplus materials, rubbish, and construction facilities from the site.

1.4 STARTING OF SYSTEMS

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Architect/Engineer and Owner seven days prior to start-up of each item.

C. Verify each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.

D. Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.

E. Verify wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of applicable manufacturer’s representative in accordance with manufacturer’s instructions.
G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

H. Submit a written report in accordance with Section 01 33 00 - Submittal Procedures that equipment or system has been properly installed and is functioning correctly.

1.5 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of products to Owner’s personnel two weeks prior to date of Substantial Completion.

B. Demonstrate Project equipment and instruct in classroom environment located at Project and instructed by qualified manufacturer’s representative who is knowledgeable about the Project.

C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

D. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner’s personnel in detail to explain all aspects of operation and maintenance.

E. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at designated location.

F. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

G. Required instruction time for each item of equipment and system is specified in individual sections.
1.6 TESTING, ADJUSTING, AND BALANCING

A. Contractor shall appoint, employ, and pay for services of independent firm to perform testing, adjusting, and balancing.

B. Independent firm will perform services specified in Division 23.

C. Reports will be submitted by independent firm to Architect/Engineer indicating observations and results of tests and indicating compliance or non-compliance with requirements of Contract Documents.

1.7 PROTECTING INSTALLED CONSTRUCTION

A. Protect installed Work and provide special protection where specified in individual specification sections.

B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

E. Prohibit traffic or storage upon roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from roofing material manufacturer.

F. Prohibit traffic from landscaped areas.

1.8 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   5. Reviewed Shop Drawings, Product Data, and Samples.
   6. Manufacturer’s instruction for assembly, installation, and adjusting.
B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress, not less than weekly.

E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by Addenda and modifications.

F. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:
   1. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of Work.
   2. Field changes of dimension and detail.
   3. Details not on original Contract drawings.

G. Submit documents to Architect/Engineer for initial review 10 days prior to Substantial Completion inspection.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit data bound in 8-1/2 x 11 inch (A4) text pages, three D side ring binders with durable plastic covers.

B. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.

C. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

D. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
E. Contents: Prepare a Table of Contents for each volume, with each Product or system description identified, typed on 20 pound white paper, in three parts as follows.

1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers.

2. Part 2: Operation and maintenance instructions, subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
   a. Significant design criteria.
   b. List of equipment.
   c. Parts list for each component.
   d. Operating instructions.
   e. Maintenance instructions for equipment and systems.
   f. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.

3. Part 3: Project documents and certificates, including the following:
   a. Shop drawings and product data.
   b. Air and water balance reports.
   c. Certificates.
   d. Originals of warranties and bonds.

F. Submit manuals to Architect/Engineer for initial review 10 days prior to Substantial Completion inspection.

1.10 SPARE PARTS AND MAINTENANCE PRODUCTS

A. Furnish spare parts, maintenance, and extra products in quantities specified in individual specification sections.

B. Deliver to Project site and place in location as directed by Owner; obtain receipt 10 days prior to Substantial Completion inspection.
1.11 PRODUCT WARRANTIES AND PRODUCT BONDS

A. Obtain warranties and bonds executed in duplicate by responsible subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.

B. Execute and assemble transferable warranty documents and bonds from Subcontractors, suppliers, and manufacturers.

C. Verify documents are in proper form, contain full information, and are notarized.

D. Co-execute submittals when required.

E. Include Table of Contents and assemble in three D side ring binder with durable plastic cover.

F. Submit to Architect/Engineer for initial review 10 days prior to Substantial Completion inspection.

G. Time of Submittals:
   1. For equipment or component parts of equipment put into service during construction with Owner’s permission, submit documents within ten days after acceptance.
   2. Make other submittals within ten days after Date of Substantial Completion, prior to final Application for Payment.
   3. For items of Work for which acceptance is delayed beyond date of Substantial Completion, submit within ten days after acceptance, listing date of acceptance as beginning of warranty or bond period.

1.12 MAINTENANCE SERVICE

A. Furnish service and maintenance of components indicated in specification sections for time periods indicated.

B. Examine system components at frequency consistent with reliable operation. Clean, adjust, and lubricate as required.

C. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by manufacturer of original component.
D. Do not assign or transfer maintenance service to agent or Subcontractor without prior written consent of Owner.

2. PART 2 PRODUCTS

Not Used.

3. PART 3 EXECUTION

3.1 SCHEDULE

E. Closeout documents, operation and maintenance data, warranties and bonds, extra materials, and maintenance agreements shall be submitted for, but not limited to, the items listed in each Section of Specifications. Submittals, in addition to those listed, include those identified in PART 1 of this Section.

END OF SECTION
CLOSEOUT CHECKLIST

INSTRUCTIONS TO CONTRACTOR

Contract Closeout documentation shall be submitted for, but not limited to, the items listed in the Project Manual. The following is a summary list of submittals required for the Project.

REFERENCES

SECTION 01 11 00 - SUMMARY OF WORK: Includes Owner occupancy.
SECTION 01 40 00 - QUALITY REQUIREMENTS: Includes manufacturer's field service reports.
SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS: Includes closeout of construction facilities and temporary controls.
SECTION 01 70 00 - EXECUTION AND CLOSEOUT REQUIREMENTS: System start-up and adjusting.

Date Completed

1. Provide Architect/Engineer seven days notice of startup of equipment. Architect/Engineer will attend startup when practicable.

2. Perform startup of all equipment and systems. General startup requirements, Division 01, apply to all equipment, whether supplemented in product section or not. Product sections include supplemental requirements.

3. Submit written report that equipment system has been properly installed, cleaned, tested, and adjusted, and is functioning properly.

4. Provide demonstration and instruction to Owner. General requirements are specified in Division 01; may be supplemented in product sections.
5. Submit Operation and Maintenance Manuals for Architect/Engineer initial review ten days prior to Substantial Completion Inspection; include mechanical test and balance reports and electrical data cable test reports. Operation and Maintenance documentation to be submitted as indicated in product sections of Project Manual. *(1 hardcopy set)*

6. Submit Warranties (and Bonds, when required) with initial Operation and Maintenance Manuals. All warranties shall be signed by Contractor. Include subcontractor’s signature when subcontractor shares responsibility. Warranty (and Bond) documentation to be submitted as indicated in product sections of Project Manual. *(1 hardcopy set)*

7. Submit Project Record Contract Drawings and Specifications for Architect/Engineer’s initial review ten days prior to Substantial Completion inspection.
   a. Contract Drawings (commonly referred as As-Builts). *(1 hardcopy set)*
   b. Specifications. *(1 set)*
   c. Addenda. *(1 set)*

8. Request for Substantial Completion.
   b. Contractor to submit list of items to be completed or corrected to Architect/Engineer (AIA A201, Paragraph 9.8.2).
   c. Contractor completes items on list.
   d. Contractor notifies Architect/Engineer when all items are completed.
   e. Architect/Engineer makes Substantial Completion Inspection.
   f. Architect/Engineer issues Substantial Completion Certificate.
   g. Owner and Contractor sign Substantial Completion Certificate.
9. Following execution of Substantial Completion Certificate, Contractor may request of all or part of retained funds, pending receipt of the following:
   a. Contractor to submit sworn statement that subcontractors, sub-subcontractors, and suppliers have been notified of Contractor's pending request for release of retained funds.
   b. Contractor to submit itemized list of items left to complete, including estimated value of labor and materials.
   c. Contractor to submit itemized list of Iowa Code Chapter 573 claims.

10. Architect/Engineer returns Operation and Maintenance Manuals; approximately one week after Substantial Completion Inspection, for making noted corrections.

11. Architect/Engineer returns Project Record Drawings and Specifications, and Addendum; approximately one week after Substantial Completion Inspection, for making noted corrections.

12. Provide submittals to Owner that are required by governing or other authorities (Includes certificates of occupancy, and plumbing and electrical inspection certificates.)

13. Submit AIA Forms [and State Sales Tax Refund forms] with claim for Final Application for Payment (Architect/Engineer will provide AIA forms for use by Contractor)
   a. AIA Document G706 - Contractor's Affidavit of Payment of Debts and Claims. (2 copies)
   b. AIA Document G706A - Contractor's Affidavit of Release of Liens. (2 copies)
   c. AIA Document G707 - Consent of Surety of Final Payment. (2 copies)

14. Provide written conformation from governmental agencies that all permit and inspection fees have been paid by Contractor.
15. Submit Project Closeout Documentation with claim for release of retained funds.
   a. Change Orders and other Modifications to Contract. *(1 set)*
   b. Reviewed shop drawings and product data. *(1 set)*
   c. Manufacturer's instructions for assembly, installation, and adjusting. *(1 set)*

16. Submit Final Operation, Maintenance, and Warranty Manuals with claim for release of retained funds. *(1 hardcopy set + 1 electronic copy)*

17. Submit Final Project Record Drawings and Specifications, and Addendum with claim for release of retained funds. *(1 hardcopy set + 1 electronic copy)*

18. Deliver extra materials, including spare parts and maintenance materials, designated storage location and obtain receipt from Owner ten days prior to Substantial Completion inspection. Unless specified otherwise, designated storage location is on site, or at Owner's close by facility. *(Receipt is Contractor's evidence that materials have been delivered. Contractor to record item and description of materials delivered, delivery date, and individual who received materials on form approved by Architect/Engineer.)* Extra materials to be provided as indicated in product sections of Project Manual.

19. Submit executed Maintenance Agreements ten days prior to Substantial Completion Inspection. *(2 copies)*
    Maintenance Agreements to be provided as indicated in product sections of Project Manual.

20. Submit written notice that The Work is fully completed and ready for Architect/Engineer and Owner Final Inspection. *(All items indicated above constitute part of the Work. The Work will not be considered complete until all items have been completed.)*
SECTION 02 41 19.13

SELECTIVE STRUCTURE DEMOLITION

1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Demolishing designated building equipment and fixtures.
   2. Demolishing designated construction.
   3. Cutting and alterations for completion of the Work.
   4. Removing designated items for reuse and Owner’s retention.
   5. Protecting items designated to remain.
   6. Removing demolished materials.

1.2 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Demolition Schedule: Indicate overall schedule and interruptions required for utility and building services.

1.3 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Accurately record actual locations of capped utilities, concealed utilities discovered during demolition, and subsurface obstructions.

1.4 QUALITY ASSURANCE

A. Conform to applicable code for demolition work, dust control, and products requiring electrical disconnection and re-connection.

B. Conform to applicable code for procedures when hazardous or contaminated materials are discovered.

C. Obtain required permits from authorities having jurisdiction.
1.5 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.6 SCHEDULING

A. Section 01 30 00 - Administrative Requirements: Requirements for scheduling.

B. Schedule Work to coincide with new construction.

C. Cooperate with Owner in scheduling noisy operations and waste removal that may impact Owners operation in adjoining spaces.

D. Coordinate utility and building service interruptions with Owner.
   1. Do not disable or disrupt building fire or life safety systems without three days prior written notice to Owner.
   2. Schedule tie-ins to existing systems to minimize disruption.
   3. Coordinate Work to ensure fire sprinklers, fire alarms, smoke detectors, emergency lights, exit signs and other life safety systems remain in full operation in occupied areas.

1.7 PROJECT CONDITIONS

A. Conduct demolition to minimize interference with adjacent occupied building areas.

B. Cease operations immediately if structure appears to be in danger and notify Architect/Engineer. Do not resume operations until directed.

2. PART 2 PRODUCTS

Not Used.
3. PART 3 EXECUTION

3.1 PREPARATION

A. Notify affected utility companies before starting work and comply with their requirements.

B. Mark location and termination of utilities.

C. Erect, and maintain temporary barriers and safety devices at locations indicated or required, including warning signs and lights, and similar measures, for the protection of the public, Owner, and existing improvements to remain.

D. Erect and maintain temporary partitions to prevent spread of dust, odors, and noise to permit continued Owner occupancy.

E. Prevent movement of structure; provide temporary bracing and shoring required to ensure safety of existing structure.

F. Provide appropriate temporary signage including signage for exit or building egress.

G. Do not close or obstruct building egress path.

H. Do not disable or disrupt building fire or life safety systems without three days prior written notice to Owner.

3.2 SALVAGE REQUIREMENTS

A. Coordinate with Owner to identify building components and equipment required to be removed and delivered to Owner.

B. Tag components and equipment Owner designates as salvage.

C. Protect designated salvage items from demolition operations until items can be removed.

D. Carefully remove building components and equipment indicated to be salvaged.

E. Disassemble as required to permit removal from building.

F. Package small and loose parts to avoid loss.
G. Mark equipment and packaged parts to permit identification and consolidation of components of each salvaged item.

H. Prepare assembly instructions consistent with disassembled parts. Package assembly instructions in protective envelope and securely attach to each disassembled salvaged item.

I. Deliver salvaged items to Owner. Obtain signed receipt from Owner.

3.3 DEMOLITION

A. Conduct demolition to minimize interference with adjacent occupied building areas.

B. Maintain protected egress from and access to adjacent existing buildings at all times.

C. Do not close or obstruct roadways sidewalks without permits.

D. Cease operations immediately when structure appears to be in danger and notify Architect/Engineer.

E. Disconnect and remove designated utilities within demolition areas.

F. Cap and identify abandoned utilities at termination points when utility is not completely removed. Annotate Record Drawings indicating location and type of service for capped utilities remaining after demolition.

G. Demolish in orderly and careful manner. Protect existing improvements and supporting structural members.

H. Carefully remove building components indicated to be reused.
   1. Disassemble components as required to permit removal.
   2. Package small and loose parts to avoid loss.
   3. Mark components and packaged parts to permit reinstallation.
   4. Store components, protected from construction operations, until reinstalled.

I. Remove demolished materials from site except where specifically noted otherwise. Do not burn or bury materials on site.
J. Remove materials as Work progresses. Upon completion of Work, leave areas in clean condition.

K. Remove temporary Work.

3.4 SCHEDULE

A. Selection Structure Demolition:
   1. Remove existing materials and equipment indicated as 'Remove'.
   2. Remove existing materials and equipment indicated as 'Relocate(d)' on Drawings; clean, adjust, and reinstall at locations indicated.
   3. Remove existing materials and equipment indicated as 'Salvage' on Drawings; package, label, and deliver to Owner at location designated by Architect/Engineer.
   4. Owner will remove materials and equipment indicated as 'Owner Remove' on Drawings; removal to take place before start of demolition.
   5. Protect existing materials and equipment indicated to 'Remain'.

END OF SECTION
SECTION 03 30 00

CAST-IN-PLACE CONCRETE

1. PART 1  GENERAL

1.1  SUMMARY

A. Section Includes:
   1. Slabs on grade.
   2. Control, expansion and contraction joint devices.

B. Related Requirements:
   1. Section 07 92 00 - Joint Sealants.
   2. Division 22 - Plumbing: Plumbing items for casting into concrete.
   4. Division 26 - Electrical: Electrical items for casting into concrete.

1.2  REFERENCE STANDARDS

A. American Concrete Institute:
   1. ACI 301 - Specifications for Structural Concrete.
   2. ACI 318 - Building Code Requirements for Structural Concrete.

B. ASTM International:
   1. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
   7. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Provide data on joint devices, attachment admixtures, and accessories.

C. Design Data:
   1. Submit concrete mix design.
   2. Identify mix ingredients and proportions, including admixtures.
   3. Identify chloride content of admixtures and whether or not chloride was added during manufacture.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301 and ACI 318.

B. Acquire cement and aggregate from one source for Work.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

B. Maintain concrete temperature after installation at minimum 50 degrees F for minimum 7 days.

1.6 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.
2. PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

A. Cement: ASTM C150, Type I - Normal or Type IA - Air Entraining.

B. Normal Weight Aggregates: ASTM C33:
   1. Coarse Aggregate use Designation:
      a. Gravel may be used for footings and concrete concealed below grade.
      b. Crushed stone is acceptable for all concrete work.
   2. Coarse Aggregate Size:
      a. Nominal maximum size shall the least dimension of the following:
         1) 1/5 of the narrowest dimension of a concrete member.
         2) 3/4 of the clear spacing between reinforcing bars.
         3) 1/3 of the depth of slabs.

C. Water: ACI 318; potable, without deleterious amounts of chloride ions.

2.2 ADMIXTURES

A. Manufacturers:
   1. BASF Construction Chemicals, LLC
   2. Grace.
   4. Substitutions: Section 01 60 00 - Product Requirements.

B. Air Entrainment: ASTM C260.


D. Flyash: ASTM C618 Class C.

E. Silica Fume: ASTM DC1240.

F. Slag: ASTM C989; Grade 100 or 120; ground granulated blast furnace slag.
G. Plasticizing: ASTM C1017/C1017M; Type I, plasticizing, Type II, plasticizing and retarding.

2.3 ACCESSORIES

A. Vapor Retarder: ASTM E1745 Class A; 15 mil thick, type recommended for below grade application. Furnish joint tape recommended by manufacturer.

2.4 CONCRETE MIX

A. Provide CLASS A concrete to the following criteria:

<table>
<thead>
<tr>
<th>Material and Property</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressive Strength (7 day)</td>
<td>2670 psi</td>
</tr>
<tr>
<td>Compressive Strength (28 day)</td>
<td>4000 psi</td>
</tr>
<tr>
<td>Water/Cement Ratio (maximum)</td>
<td>0.48 by weight (mass);</td>
</tr>
<tr>
<td>Air Content</td>
<td>0 to 3.0 percent</td>
</tr>
<tr>
<td>Pozzolan Content</td>
<td>Maximum 25 percent of cementitious material content</td>
</tr>
<tr>
<td>Slump</td>
<td>4 inches plus or minus 1 inch</td>
</tr>
</tbody>
</table>

B. Admixtures: Include admixture types and quantities indicated in concrete mix designs only when approved by Architect/Engineer.
1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
2. Use accelerating admixtures in cold weather. Use of admixtures will not relax cold weather placement requirements.
3. Use water-reducing and retarding admixture in high temperatures, low humidity, or other adverse placement conditions. Use of admixtures will not relax hot weather placement requirements.
4. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
5. Limit slump to 8 inches when using high-range water-reducing or plasticizing admixtures. Verify concrete slump of 2 to 4 inches prior to addition of admixtures.

6. Do not use calcium chloride nor admixtures containing calcium chloride.

C. Ready Mixed Concrete: Mix and deliver concrete in accordance with ASTM C94/C94M.

2.5 CURING COMPOUNDS

A. Non-Membrane Forming Curing Compound: Water-soluble, sodium-silicate-based type, clear, non-residual, without fugitive dye; combination curing, hardening, and dustproofing compound. Follow manufacturer’s recommended application for use as curing compound.

1. Manufacturers:
   a. BASF - Product: MasterKure HD 100WB.
   c. Euclid Chemical - Product: Eucosil.
   e. Substitutions: Section 01 60 00 - Product Requirements.

3. PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify requirements for concrete cover over reinforcement.

C. Verify vapor retarders are in place.

3.2 PREPARATION

A. Prepare previously placed concrete by cleaning with steel brush to remove laitance, coatings, and unsound materials.

B. Remove water from areas receiving concrete before concrete is placed.
3.3 MIXING AND DELIVERING CONCRETE

A. Equipment and Operations: ASTM C94.

B. Schedule: Deliver concrete so that continuity of pour is not interrupted for more than 15 minutes from time one truck is emptied, until another truck is in position to continue pour.

C. Plant Certificates: Leave copy at jobsite for each batch, stating exact amount of each ingredient, including amount of water added after departure from plant and prior to placement.

3.4 PLACING CONCRETE

A. Place concrete in accordance with ACI 301 and ACI 318.

B. Install vapor retarder under interior slabs on grade in accordance with ASTM E1643. Lap joints minimum 6 inches and seal watertight by taping edges and ends.

C. Repair vapor retarder damaged during placement of concrete reinforcing. Repair with vapor retarder material; lap over damaged areas minimum 6 inches and seal watertight.

D. Deposit concrete at final position. Prevent segregation of mix.

E. Place concrete in continuous operation for each panel or section determined by predetermined joints.

F. Consolidate concrete.

G. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

H. Place concrete continuously between predetermined expansion, control, and construction joints.

I. Do not interrupt successive placement; do not permit cold joints to occur.

J. Screed floors and slabs on grade level, maintaining surface flatness.
3.5 JOINTS

A. Saw Cut Joints:
   1. Saw cut joints within 4 to 12 hours after concrete placement. Using 3/16 inch thick blade, cut to 1/3 depth of slab thickness. Locate joints in slabs on grade and finished fills as indicated; where not indicated locate joints not to exceed 10 feet in either direction.
   2. At completion, clean joints and fill with dry, packed, washed sand, which shall be left in place until joint sealing, to be executed under another Section, is ready to be started. Then remove sand from joints and leave them in condition to receive sealant.

3.6 CONCRETE FINISHING

A. Finish concrete floor surfaces in accordance with ACI 318.

B. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains as indicated on drawings.

3.7 CURING AND PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Apply Non-Membrane Forming Curing Compound in one coat. Maintain surface wet with curing compound, without ponding for time recommended by manufacturer.

END OF SECTION
1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Mortar and grout for masonry.

B. Related Requirements:
   1. Section 04 20 00 - Unit Masonry: Installation of mortar and grout.
   2. Section 08 12 13.13 - Standard Hollow Metal Frames: Grouting hollow metal door frames.

1.2 REFERENCE STANDARDS

A. ASTM International:

B. The Masonry Society:
   1. TMS 402 - Building Code Requirements for Masonry Structures.
   2. TMS 602 - Specification for Masonry Structures.
1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Mix Designs: For each type of mortar and grout. Include description of type, proportions, and ingredients.
   1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91 for air content.
   2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.

C. Manufacturer’s Installation Instructions: Submit premix mortar manufacturer’s installation instructions.

D. Manufacturer’s Certificate: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 530 and ACI 530.1.

B. Source Limitation for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry. Obtain ingredients from a single source or producer for each product required.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Cold Weather Requirements: In accordance with ACI 530.1 when ambient temperature or temperature of masonry units is less than 40 degrees F.

C. Hot Weather Requirements: In accordance with ACI 530.1 when ambient temperature is greater than 100 degrees F or ambient temperature is greater than 90 degrees F with wind velocity greater than 8 mph.
2. PART 2 PRODUCTS

2.1 MORTAR AND MASONRY GROUT

A. Manufacturers - Cement:
   1. CTS Cement Manufacturing Co.
   2. Lafarge North America.
   4. The Quikrete Companies.
   5. Substitutions: Section 01 60 00 - Product Requirements.

B. Manufacturers - Premix Mortar:
   1. Reference Manufacturer: Spec Mix, Inc.
   2. Substitutions: Section 01 60 00 - Product Requirements.

2.2 COMPONENTS

A. Portland Cement: ASTM C150, Type I, gray or white color as required. Use one brand throughout, for mortar.

B. Mortar Cement: Not permitted.

C. Premix Mortar: ASTM C387, Types M, N, or S, using gray or white color cement as required. Use one brand throughout, for mortar.


E. Mortar Color: Mineral oxide pigment; chemically inert, alkali-fast, unfading.

F. Grout Aggregate: ASTM C404, fine and coarse.

G. Water: Clean and potable.

H. Calcium chloride is not permitted.

I. Anti-freeze in not permitted.
2.3 MIXES

A. Mortar Mixes:

B. Mortar Mixing:
   1. Thoroughly mix mortar ingredients in accordance with ASTM C270 in quantities needed for immediate use.
   2. Achieve uniformly damp sand immediately before mixing process.
   3. Re-temper only within two hours of mixing.

C. Grout Mixes:
   1. Grout For Non-Structural Masonry: 2,000 psi strength at 28 days; 8-11 inches slump; mixed in accordance with ASTM C476 Fine and Coarse grout.
   2. Grout For Structural Masonry: 2,000 psi strength at 28 days; 8-11 inches slump; mixed in accordance with ASTM C476 Fine and Coarse grout.
   3. Application:
      a. Coarse Grout: For grouting spaces with minimum 4 inches dimension in every direction.
      b. Fine Grout: For grouting other spaces.

D. Grout Mixing:
   1. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476.
   2. Re-tempering is not permitted.

3. PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Request inspection of spaces to be grouted.
3.2 INSTALLATION

A. Install mortar and grout in accordance with Section 04 20 00.

3.3 FIELD QUALITY CONTROL

A. Testing Frequency: One set of specified tests for every 5,000 sf of completed wall area.

B. Testing of Mortar Mix: In accordance with ASTM C780 for aggregate ratio and water content, air content, consistency, and compressive strength.

C. Testing of Grout Mix: In accordance with ASTM C1019 for compressive strength, and in accordance with ASTM C143/C143M for slump.

3.4 SCHEDULE

A. Masonry Mortar:
   1. Face Brick:
      a. Setting Mortar: Type N.
   2. Concrete Masonry Units:
      a. Setting Mortar: Type S.

END OF SECTION
SECTION 04 20 00

UNIT MASONRY

1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Face brick and concrete masonry units.
   2. Reinforcement, anchorage, and accessories.

B. Related Requirements:
   1. Section 04 05 03 - Masonry Mortaring and Grouting: Mortar and grout.
   2. Section 05 50 00 - Metal Fabrications: Product requirements for loose steel lintels and fabricated steel items for placement by this section.

1.2 REFERENCE STANDARDS

A. ASTM International:
   1. ASTM A153/A153M - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   3. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.
   4. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale).

B. The Masonry Society:
   1. TMS 402 - Building Code Requirements for Masonry Structures.
   2. TMS 602 - Specification for Masonry Structures.
1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data for the following:
   1. Fabricated wire reinforcement, wall ties, anchors, and accessories.
   2. Cleaning solutions and sealers.
   3. Concrete Masonry Units, indicating that it conforms with ASTM C90.

C. Manufacturer’s Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

D. Manufacturer’s Certificates: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE


B. Source Limitation for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or uniform blend within the ranges accepted for these characteristics. Obtain units from a single source and single manufacturer for each product required.

C. Source Limitation 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.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section.

B. Installer: Company specializing in performing Work of this section.
1.6 PRE-INSTALLATION MEETING
A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
B. Convene minimum one week prior to starting work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
B. Accept concrete masonry units on site. Inspect for damage.

1.8 COORDINATION
A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
B. Coordinate masonry work with installation of door frame anchors.

2. PART 2 PRODUCTS

2.1 FACING BRICK
A. Salvaged Face Brick: From demolition operations, use to fullest extent possible, in lieu of new face brick, in locations where salvaged face brick will result in best match to existing adjacent wall.

2.2 CONCRETE MASONRY UNITS
A. Hollow Load-Bearing Concrete Masonry Units (CMU): ASTM C90, Grade N, Type I - Moisture Controlled; normal weight.
B. Masonry Units Special Shapes: Provide special units for 90 degree corners, bond beams, lintels, and bullnosed corners.
   1. Bullnosed Corners: where indicated on Drawings.
2.3 **REINFORCEMENT AND ANCHORAGE**

A. Manufacturers:
   1. Heckmann Building Products, Inc.
   2. Hohmann & Barnard, Inc.
   3. Masonry Reinforcing Corp. of America
   4. Substitutions: Section 01 60 00 - Product Requirements.

2.4 **MORTAR AND GROUT**

A. Mortar and Grout: As specified in Section 04 05 03.

2.5 **MISCELLANEOUS MASONRY ACCESSORIES**

A. Cleaning Solution: As recommended by masonry manufacturer; concentrated acidic cleaner, not harmful to masonry work or adjacent materials. Use of muriatic acid as cleaning solution is not permitted.

2.6 **LINTELS**

A. Steel Lintels: Install loose steel lintels over openings not indicated or scheduled on Drawings, per Section 05 50 00.

3. **PART 3 EXECUTION**

3.1 **EXAMINATION**

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify field conditions are acceptable and are ready to receive work, and that:
   1. Maximum variation from specified width or length of foundations does not exceed ±1/2 inch.
   2. Maximum variation in alignment of foundations does not exceed ±1/4 inch in 10 feet.
   3. Maximum variation from grade and elevation of foundations does not exceed ±1/2 inch.
   4. Maximum variation from level or specified slope of foundations does not exceed ±1/4 inch in 10 feet.
C. Verify items provided by other sections of work are properly sized and located.

D. Verify built-in items are in proper location, and ready for roughing into masonry work.

3.2 EXISTING WORK

A. Extend existing unit masonry installations using materials and methods as specified.

B. Repair and remodel existing masonry assemblies which remain or are to be altered.

C. Remove abandoned screws, nails, expansion anchors, and expansion anchor sleeves previously used to hang or support components off of wall and fill unused exposed-to-view holes in existing unit masonry. Point with mortar, compact, and finish smooth.

3.3 PREPARATION

A. Direct and coordinate placement of metal anchors supplied to other sections.

B. Furnish temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.4 INSTALLATION

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Coursing of Masonry:
   1. Bond: Match existing.
D. Use full-sized units without cutting if possible. Where cutting is required to provide continuous pattern or fit to adjoining construction, cut units with motor-driven saw to provide clean, sharp, unchipped edges.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of color and texture.

3.5 PLACING AND BONDING

A. Lay hollow masonry units as follows:
   1. With face shells fully bedded in mortar with head joints of depth equal to bed joints.
   2. With webs fully bedded in mortar in grouted masonry, including starting course on footings.

B. Remove excess mortar as work progresses.

C. Perform job site cutting of masonry units with proper tools to assure straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

3.6 GROUTED COMPONENTS

A. At bearing locations of lintels, fill masonry cores with grout for minimum 8 inches either side of opening. Grout to extend a minimum of one full courses below bearing.

3.7 LINTELS

A. Provide masonry or steel lintel above openings greater than 12 inches for brick and 24 inches for CMU openings.
   1. If two adjacent openings are less than 8 inches apart, provide a single lintel over both openings, with the length determined by the combined opening width.

B. Maintain minimum 6 inch bearing on each side of opening.

3.8 CUTTING AND FITTING

A. Cut and fit for chases, pipes, conduit, sleeves, and grounds. Coordinate with other sections of work to provide correct size, shape, and location.
B. Obtain Architect/Engineer’s approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.9 PATCHING, FILLING AND REBUILDING EXISTING MASONRY

A. Where indicated, or necessary to carry out work of other trades, provide modifications, alterations or replacement of existing masonry. Use salvage face brick where salvaged face brick will result in best match to existing adjacent wall.

3.10 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation From Alignment (bottom vs. top): ±1/2 inch for bearing walls; ±3/4 inch for non-bearing walls.

C. Maximum Variation in Level From Unit to Adjacent Unit: ±1/32 inch.

D. Maximum Variation From Plane of Wall: ±1/4 inch in 10 feet; ±3/8 inch in 20 feet; ±1/2 inch maximum.

E. Maximum Variation From Plumb: ±1/4 inch in 10 feet; ±3/8 inch in 20 feet; ±1/2 inch maximum.

F. Maximum Variation From Level Coursing:
2. Top surface of bearing walls: ±1/4 inch in 10 feet; ±1/2 inch maximum.

G. Maximum Variation of Joint Thickness:

H. Maximum Variation From Cross Sectional Thickness of Walls: ±1/4 inch.

I. Maximum Variation For Location of Elements:
1. Indicated in Plan: ±1/2 inch in 20 feet; ±3/4 inch maximum.
J. Maximum Variation for Placement of Reinforcement In Flexural Elements and Walls:
   1. ±1/2 inch, when distance from centerline of steel to opposite face of masonry (d) is 8 inches or less.
   2. ±1 inch, when 8 inches < d ≤ 24 inches.
   3. ±1 1/4 inches, when d > 24 inches.
   4. In walls, for vertical bars, 2 inches from the location along the length of wall indicated on the Drawings.

3.11 CLEANING

   A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
   B. Remove excess mortar and mortar smears as work progresses.
   C. Replace defective mortar. Match adjacent work.
   D. Clean soiled surfaces with cleaning solution. Use non-metallic tools in cleaning operations.

3.12 PROTECTION OF FINISHED WORK

   A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.
   B. Protect exposed external corners subject to damage.
   C. Protect base of walls from mud and mortar splatter.
   D. Protect masonry and other items built into masonry walls from mortar droppings and staining caused by mortar.
   E. When work is not in progress, protect tops of masonry work with waterproof coverings secured in place without damaging masonry. Provide coverings where masonry is exposed to weather.
   F. Immediately remove decorative concrete masonry sealer from any surface not scheduled to receive sealer. Remove by methods as instructed by sealer manufacturer.
SECTION 05 50 00

METAL FABRICATIONS

1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Shop fabricated metal items.

B. Related Requirements:
   1. Section 04 20 00 - Unit Masonry: Execution requirements for embedded anchors and attachments for metal fabrications specified in this section in masonry.

1.2 REFERENCE STANDARDS

A. ASTM International:
   3. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

B. American Welding Society:
   1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
   2. AWS D1.1 - Structural Welding Code - Steel.
1.3 SUBMITTALS
A. Section 01 33 00 - Submittal Procedures: Submittals procedures.

B. Shop Drawings:
   1. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
   3. Include erection drawings, elevations, and details where applicable.

C. Welders Certificates: Certify welders employed on Work, verifying AWS qualification within previous 12 months.

1.4 DELIVERY, STORAGE, AND HANDLING
A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Accept metal fabrications on site in labeled shipments. Inspect for damage.

C. Protect metal fabrications from damage by exposure to weather.

1.5 FIELD MEASUREMENTS
A. Verify field measurements are as indicated on shop drawings.

2. PART 2 PRODUCTS
2.1 MATERIALS - STEEL
A. Structural W-Shapes: ASTM A992/A992M; Grade 50.

B. Channels, angles, and plates: ASTM A36/A36M.

C. Hollow Structural Sections: ASTM A500, Grade B.

D. Anchor Rods: ASTM F1554; Grade 55, weldable. Grade A.
   1. Finish: Unfinished.
E. Bolts: ASTM A325; Type 1.
   1. Finish: Unfinished.

F. Nuts: ASTM A563 heavy hex type.
   1. Finish: Unfinished.

G. Washers: ASTM F436; Type 1.
   1. Finish: Unfinished.

H. Welding Materials: AWS D1.1; type required for materials being welded.

I. Shop Primer: SSPC Paint 15, Type 1, red or gray oxide.

2.2 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Continuously seal joined members by intermittent welds and plastic filler, or continuous welds where indicated.

D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

F. Supply components required for anchorage of fabrications, concealed where practicable. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.3 FACTORY APPLIED FINISHES - STEEL

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Do not prime surfaces in direct contact with concrete or where field welding is required.
C. Prime paint items with one coat; minimum 1.5 mil dry thickness.

2.4 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

3. PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify field conditions are acceptable and are ready to receive Work.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal [and] [aluminum] where site welding is required.

B. Supply items required to be embedded in masonry with setting templates to appropriate sections.

3.3 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Make provisions for erection stresses. Install temporary bracing to maintain alignment, until permanent bracing and attachments are installed.
C. Field weld components indicated on shop drawings.

D. Perform field welding in accordance with AWS D1.1.

E. Obtain approval of Architect/Engineer prior to site cutting or making adjustments not scheduled.

F. After erection, touch up welds, abrasions, and damaged finishes with prime paint or galvanizing repair paint to match shop finishes.

3.4 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation From Plumb: 1/4 inch per story or for every 12 ft in height whichever is greater, non-cumulative.

C. Maximum Offset From True Alignment: 1/4 inch.

3.5 SCHEDULE

A. Metal Fabrications:
   1. The Schedule is a list of principal items only. Refer to Drawing details for items not specifically scheduled.
   2. Brackets for Wall Mounted Vanities and Counters: Steel bracket assemblies as indicated; through-bolt anchors with oversized washers; drill for attachment to wood. Prime paint finish.
   3. Lintels: Install loose steel lintels over openings.
      a. As detailed; prime paint finish.
      b. Complete with anchor devices, fitted for adjustment, and assembled.
      c. Lintels, for all openings not otherwise indicated. Minimum lintels for each 4 inches of masonry width shall be:
         1) Spans less than 2'-0": Place plate 5/16 thickness.
         2) Spans up to 4'-0": Place one L 3.5x3.5x2x5/16.
         3) Spans up to 8'-0": Place one L 5x3.5x5/16.
         4) Spans up to 10'-0": Place one L 6x3.5x5/16.
         5) Eight inches minimum length of bearing.
         6) Prime paint finish.

END OF SECTION
1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Roof curbs and perimeter nailers.
   2. Blocking in wall and roof openings.
   3. Concealed wood blocking for support of toilet and bath accessories and wall cabinets.
   4. Concealed wood blocking for support of wall cabinets and equipment furnished by Owner.
   5. Plywood sheathing.

1.2 REFERENCE STANDARDS

A. American Wood-Preservers’ Association:
   1. AWPA M4 - Standard for the Care of Preservative-Treated Wood Products.

B. ASTM International:

C. Southern Pine Inspection Bureau:
   1. SPIB - Standard Grading Rules for Southern Pine Lumber.

D. U.S. Department of Commerce National Institute of Standards and Technology:
   1. DOC PS 1 - Construction and Industrial Plywood.
   2. DOC PS 2 - Performance Standards for Wood-Based Structural-Use Panels.
1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit technical data on wood-preservative treatment materials.

1.4 QUALITY ASSURANCE

A. Perform Work according to the following:
   2. Lumber: DOC PS 20.

B. Apply label from agency approved by authority having jurisdiction to identify each preservative-treated material.

2. PART 2 PRODUCTS

2.1 MATERIALS

A. Lumber Grading Rules: SPIB.

B. Miscellaneous Blocking: Southern Pine species; 19 percent maximum moisture content, pressure preservative treatment.

C. Plywood: APA-rated sheathing, Grade C-D, Exposure 1, unsanded.

2.2 FACTORY WOOD TREATMENT

A. Wood Preservative (Pressure Treatment): AWPA UC1, commodity specification A-sawn products or F-wood composites using waterborne CA-B preservative; minimum retention as required by service conditions and use environment.

B. Wood Preservative (Surface Application): Clear type; type recommended by manufacturer of factory pressure treated products.

C. Moisture Content After Treatment: Kiln dried (KDAT).
   1. Lumber: Maximum 19 percent.
2.3 ACCESSORIES

A. Fasteners and Anchors:
   1. Fasteners: ASTM A153, hot-dipped galvanized (nails, screws, and lag screws) or ASTM B695, Class 55 mechanically galvanized (fasteners other than those listed above) steel for high-humidity and treated wood locations, unfinished steel elsewhere.
   2. Anchors: Toggle bolt type for anchorage to hollow masonry; expansion shield and lag bolt type for anchorage to solid masonry or concrete; bolt or ballistic fastener for anchorages to steel, and bolts with plate washers for wall plates.

3. PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that substrate conditions are ready to receive blocking and curbing.

3.2 PREPARATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Coordinate placement of blocking and curbing items.

3.3 INSTALLATION

A. Set members level and plumb, in correct position.

B. Place horizontal members flat, crown side up.

C. Construct curb members of solid wood sections.

D. Curb roof openings except where prefabricated curbs are provided. Form corners by alternating lapping side members.

E. Form blocking to shapes and sizes indicated or required to suit conditions.
F. Form blocking in conjunction with masonry to same size as masonry unit which it replaces. Anchor with toggle bolts.

G. Coordinate curb installation with installation of decking and support of deck openings, prefabricated roof curbs, and insulation.

H. Coordinate blocking with installation of toilet and bath accessories, wall cabinets, and equipment.

I. Coordinate blocking with installation of wall cabinets and equipment furnished by Owner.

J. Secure plywood to existing substrate with mechanical fasteners.

3.4 SITE-APPLIED WOOD TREATMENT

A. Treat Site-sawn cuts. Apply preservative to Site-sawn cuts according to AWPA M4.

B. Allow preservative to dry prior to erecting members.

3.5 SCHEDULE

A. Miscellaneous Rough Carpentry:
   1. Pressure-Preservative Treatment Locations:
      a. Blocking and plywood in contact with masonry or concrete.
      b. Blocking, curbing, and nailers in conjunction with roofing.

END OF SECTION
SECTION 06 61 16
SOLID SURFACING FABRICATIONS

1. PART 1  GENERAL

1.1  SUMMARY

A. Section Includes:
   1. Window stools.

B. Related Requirements:
   1. Section 06 10 53 - Miscellaneous Rough Carpentry: Wood support framing.

1.2  REFERENCE STANDARDS

A. American National Standards Institute:
   1. ANSI Z124.3 - Plastic Lavatories.
   2. ANSI Z124.6 - Plastic Sinks.

B. ASTM International:

C. National Electrical Manufacturers Association:
   1. NEMA LD 3-2000 - High-Pressure Decorative Laminates.
D. National Fire Protection Association:

E. Underwriters Laboratories Inc.:
   1. UL - Fire Resistance Directory.
   2. UL 723 - Test for Surface Burning Characteristics of Building Materials.

1.3 SEQUENCING

A. Section 01 10 00 - Summary: Requirements for Work sequencing.

B. Sequence Work to permit installation of adjacent affected construction.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data on specified component products and connection requirements.

C. Shop Drawings: Indicate dimensions, thicknesses, required clearances, tolerances, materials, colors, finishes, fabrication details, field jointing, adjacent construction, methods of support, and anchorage.

D. Samples: Submit two samples representative of window sill, 4 x 4 inches in size, illustrating color, texture, and finish.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Operation and Maintenance Data: Submit list of approved cleaning materials and procedures required; list substances harmful to component materials. Include instructions for stain removal and surface and gloss restoration.
1.6 QUALITY ASSURANCE

A. Surface Burning Characteristics: Maximum 25/450 flame-spread/smoke-developed index when tested in accordance with ASTM E84.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section.

B. Fabricator: Company specializing in fabricating Products specified in this Section.

1.8 DELIVERY, STORAGE AND HANDLING

A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for product delivery, storage, and handling.

B. Deliver sheets, fabricated items, materials and components in manufacturer’s original, unopened, undamaged containers with identification labels intact.

C. Store solid surface products and accessories as recommended by manufacturer.

1.9 EXISTING CONDITIONS

A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

B. Furnish 10 year manufacturer’s warranty for each type of unit.
2. PART 2 PRODUCTS

2.1 SOLID SURFACING FABRICATIONS

A. Manufacturers:
   2. Other Acceptable Manufacturers:
      a. Wilsonart.
   3. Substitutions: Section 01 60 00 - Product Requirements.

2.2 SOLID SURFACE MATERIALS

A. Solid Polymer Components:
   1. Cast, nonporous, filled polymer, not coated, laminated or of composite construction with through body colors, having minimum physical and performance properties specified.
   2. Superficial damage to depth of 0.010 inch shall be repairable by sanding and/or polishing.

B. Thickness: As Scheduled.

C. Profile: As indicated on Drawings.

D. Performance Characteristics:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test</th>
<th>Typical Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength</td>
<td>ASTM D638</td>
<td>6,000 psi</td>
</tr>
<tr>
<td>Hardness</td>
<td>ASTM D785, Rockwell &quot;M&quot; Scale</td>
<td>Greater than 85</td>
</tr>
<tr>
<td>Thermal Expansion</td>
<td>ASTM D696</td>
<td>$1.8 \times 10^{-5}$ in/in/degree C</td>
</tr>
<tr>
<td>Gloss (60 degree Gardner)</td>
<td>ANSI Z124.3 &amp; Z124.6</td>
<td>5-75 (matte - highly polished)</td>
</tr>
<tr>
<td>Wear &amp; Cleanability</td>
<td>ANSI Z124.3 &amp; Z124.6</td>
<td>Passes</td>
</tr>
<tr>
<td>Stain Resistance: Sheets</td>
<td>ANSI Z124.3 &amp; Z124.6</td>
<td>Passes</td>
</tr>
<tr>
<td>Fungus &amp; Bacteria Resistance</td>
<td>ASTM G21 &amp; G22</td>
<td>Does not support microbial growth</td>
</tr>
<tr>
<td>IZOD Impact (Notched Specimen)</td>
<td>ASTM D256 (Method)</td>
<td>0.28 ft-lbs/in of notch</td>
</tr>
</tbody>
</table>
### Ball Impact Resistance: Sheets

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEMA LD 3-2000</td>
<td>No fracture - ¼ lb ball ½&quot; slab - 144&quot; drop</td>
</tr>
</tbody>
</table>

### Water Absorption

- **ASTM D570**: Long-term ½" slab - 0.6%

### Flammability

- **ASTM E84, NFPA 255 & UL 723**: All colors (Class I and Class A)

### Flame Spread Index

- Less than 25

### Smoke Developed Index

- Less than 25

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#### 2.3 ACCESSORIES

A. **Joint Adhesive**: Manufacturer’s standard one- or two-part adhesive kit to create inconspicuous, nonporous joints.

B. **Panel Adhesive**: Manufacturer’s standard neoprene-based panel adhesive to secure components to substrate.

C. **Sealant**: Manufacturer’s standard mildew-resistant, FDA-compliant, UL-listed silicone sealant in colors matching components.

#### 2.4 FABRICATION

A. Fabricate components to greatest extent practical, to sizes and shapes indicated, in accordance with approved Shop Drawings.

B. Form joints between components using joint adhesive without conspicuous joints.

C. Rout and finish component edges with clean, sharp returns.
   1. Rout cutouts, radii and contours to template.
   2. Smooth edges.
   3. Repair or reject defective Work.

#### 2.5 FINISHES

A. Select from manufacturer’s standard color chart.
   1. Colors: As Scheduled.

B. Finish:
   1. Provide surfaces with uniform finish:
3. PART 3  EXECUTION

3.1  EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that joint preparation and affected dimensions are acceptable.

3.2  INSTALLATION

A. General: Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved Shop Drawings.
   1. Provide components in largest pieces available.
   2. Form field joints using manufacturer’s recommended adhesive, with joints inconspicuous in finished work.
      a. Exposed joints/seams shall not be allowed.
   3. Cut and finish component edges with clean, sharp returns.
   4. Rout radii and contours to template.
   5. Anchor securely to supports.
   6. Carefully dress joints smooth, remove surface scratches and clean entire surface.
   7. Install window sills with no more than 1/8 inch sag, bow or other variation from straight line.

B. Applied Window Stools:
   1. Install applied window sills using manufacturer’s recommended panel adhesive.
   2. Seal to adjacent construction.

3.3  REPAIR

A. Repair or replace damaged Work which cannot be repaired to satisfaction of Architect/Engineer.

3.4  TOLERANCES

A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.

B. Maximum Variation from Indicated Dimension: 1/8 inch.

C. Maximum Offset from Indicated Position: 1/8 inch.
3.5 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Keep components clean during installation.

C. Remove adhesives, sealants, and other stains.

3.6 SCHEDULE

A. Solid Surfacing Fabrications:
   1. Window Stools: 1/4 inch thick x depths indicated on Drawings; longest lengths available; 1 color for Project, as selected from manufacturer’s Color Groups A, B, & C.
SECTION 07 53 03
ELASTOMERIC MEMBRANE ROOFING

1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Flashings and accessories.

B. Related Requirements:
   1. Section 06 10 53 - Miscellaneous Rough Carpentry: Wood nailers and curbs.

1.2 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and Project requirements.

B. Coordinate Work of this Section with installation of associated roof curbs and penetrations.

1.3 PRE-INSTALLATION MEETING

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing Work of this Section.

C. Review preparation and installation procedures and coordinating and scheduling required with related Work.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit characteristics on flashings and accessories.
C. Shop Drawings: Indicate flashing layout, seam locations, joint and termination detail conditions, and conditions of interface with other materials.

D. Samples: Submit two samples, 8 x 8 inches in size illustrating flashings.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout submittals.

B. Warranty: Submit warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section.

B. Applicator: Company specializing in performing Work of this Section, and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer’s original packaging and inspect for damage.

C. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.

D. Store products in weather protected environment, clear of ground and moisture.
1.8 AMBIENT CONDITIONS

A. Section 01 60 00 - Product Requirements: Requirements for ambient condition control facilities for product storage and installation.

B. Do not apply flashings during inclement weather.

C. Do not apply flashings to damp or frozen roof membrane surfaces or when precipitation is expected or occurring.

D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

1.9 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

B. Furnish 2 year warranty covering Work of this Section, including flashings, signed and countersigned by Contractor and Applicator.

2. PART 2 PRODUCTS

2.1 MATERIALS

A. Flashing Membrane: Cured EPDM, pressure-sensitive; 0.060 inch thick, 20 inch wide roll; black color; manufactured by existing elastomeric membrane roofing manufacturer

2.2 ACCESSORIES

A. Wood Nailers:
   1. As specified in Section 06 10 53.
   2. Pressure preservative treated.

B. Manufactured Curbs:
   1. As specified in Division 23.

C. Roofing Nails:
   1. Galvanized, hot dipped, or non-ferrous type.
   2. Size and Configuration: As required to suit application.
D. Sealants: As recommended by membrane manufacturer.

E. Termination Bars: 3/16 x one inch galvanized steel; equip with compatible fasteners, 12 inches maximum spacing.

3. PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify surfaces and Site conditions are ready to receive Work.

C. Verify existing roof membrane surfaces are dry and free of snow or ice.

D. Verify manufactured curbs, and vents through roof are in place and solidly set.

E. Confirm existing deck membrane material and thickness and execute new Work with compatible materials.

F. Contractor shall abide with requirements of active warranty on existing elastomeric membrane roofing system, and shall obtain manufacturer’s written approval for alterations being made, as well as flashing recommendations. Under no circumstance shall existing warranty be voided.

3.2 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of flashings.

B. Clean manufactured curbs, vents through roof, and deck membrane as recommended by manufacturer.
3.3 INSTALLATION

A. At new manufactured curbs and vents through roof, provide tie-in of new flashings to existing elastomeric membrane roofing system, and at alterations or patching of existing elastomeric membrane roofing system.

B. Flashings and Accessories:
   1. Apply flashings to seal existing roof membrane to vertical elements of manufactured curbs and vents through roof as recommended by manufacturer.
   2. Extend flashings up vertical surfaces of roof curbs and vents thru roof, full height; extend over tops of manufactured curbs minimum 2 inches; reinforce corners.
   3. Secure to curb nailing strips at 4 inches oc; terminate vent thru roof flashings with stainless steel clamping ring.
   4. Seal top of flashings and flanges of items penetrating deck membrane.

3.4 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Where finished surfaces are soiled by Work of this Section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.

C. Repair or replace defaced or disfigured finishes caused by Work of this section.

3.5 PROTECTION OF INSTALLED WORK

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed work.

B. Protect building surfaces against damage from roofing work.

C. Where traffic must continue over existing roof membrane, protect surfaces as recommended by roofing manufacturer.

END OF SECTION
SECTION 07 84 00
FIRESTOPPING

1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Firestopping and through-penetration protection system materials and accessories.
   2. Firestopping tops of fire rated walls.
   3. Fire wall signs.

B. Related Requirements:
   1. Division 22 - Plumbing: Firestopping materials and accessories to firestop plumbing work.
   3. Division 26 - Electrical: Firestopping materials and accessories to firestop electrical work.
   4. Division 27 - Communications: Firestopping materials and accessories to firestop communications work.

1.2 REFERENCE STANDARDS

A. ASTM International:

B. Intertek Testing Services (Warnock Hersey Listed):
   1. WH - Certification Listings.

C. Underwriters Laboratories, Inc.:
   2. UL - Fire Resistance Directory.
1.3 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing material or assembly placed in spaces between and penetrations through building materials to arrest the movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 PERFORMANCE REQUIREMENTS

A. Conform to applicable code, UL, and WH for fire resistance ratings and surface burning characteristics.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data on product characteristics, performance and limitation criteria.

C. Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.

D. Manufacturer's Certificates:
   1. Certify products contain no asbestos or other finely-divided particulate matter that can be released as an airborne health hazard during or after installation.

E. Engineering Judgements: For conditions not covered by UL or WH listed designs, provide judgements from licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.6 QUALITY ASSURANCE

A. Through Penetration Firestopping of Fire Rated Assemblies: ASTM E814 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant ratings as indicated on Drawings for wall assembly, but not less than 1-hour.
   1. Wall Penetrations: To achieve fire resistant ratings as indicated on Drawings for wall assembly, but not less than 1-hour.
B. Fire Resistant Joints in Fire Rated Wall Assemblies: UL 2079 to achieve fire resistance rating as indicated on Drawings for assembly in which joint is installed.

C. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section.

B. Applicator: Company specializing in performing Work of this Section.

1.8 MOCKUP

A. Section 01 40 00 - Quality Requirements: Requirements for mockup.

B. Apply 1 linear foot of each type of linear firestopping material to representative substrate surface.

C. Locate where directed by Architect/Engineer.

D. Incorporate accepted mockup as part of Work.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Do not apply materials when temperature of substrate material and ambient air is below 60 degrees F.

C. Maintain this minimum temperature before, during, and for 3 days after installation of materials.

D. Provide ventilation in areas to receive solvent cured materials.
2. PART 2  PRODUCTS

2.1  FIRESTOPPING

A. Manufacturers:
   1. Grace Construction Products.
   2. Hilti Corporation.
   4. The RectorSeal Corporation
   5. Tremco Incorporated.
   6. 3M.
   7. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
   1. Elastomeric Sealant Firestopping: Single component acrylic elastomeric compound, non-intumescent, paintable.
   2. Elastomeric Spray Firestopping: Single component elastomeric mastic compound.

C. Color: Manufacturer’s standard.

2.2  ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Dam Material: Mineral fiber matting.

C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

2.3  FIRE WALL SIGNS

A. Manufacturers:
   2. Substitutions: Section 01 60 00 - Product Requirements.
B. Fire Wall Signs: Provide vinyl signs, approximately 15" W x 11" H with white background, black boarder, red '1 HOUR FIRE WALL' text, and black 'PROTECT ALL OPENINGS AND PENETRATIONS' text; text shall be not less than 0.5 inches in height.

3. PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify openings are ready to receive firestopping.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Install damming materials to arrest liquid material leakage.

3.3 APPLICATION

A. Install material at fire rated construction perimeters and openings which contain penetrating structural steel, steel joists, and other items requiring firestopping.

B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply elastomeric sealant firestopping material in sufficient thickness to achieve required fire rating, to uniform density and texture.

D. Apply elastomeric spray firestopping material in sufficient coats to achieve rating required.
E. Install fire wall signs in accessible concealed floor, floor-ceiling, and attic spaces; space signs at maximum 30 feet oc, measured horizontally along wall or partition.

3.4 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.5 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Clean adjacent surfaces of firestopping materials.

3.6 PROTECTION OF INSTALLED WORK

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed work.

B. Protect adjacent surfaces from damage by material installation.

3.7 SCHEDULE

A. Firestopping:
   1. Penetrating Items:
      a. Steel joists through gypsum board walls; wall ratings as indicated on Drawings.
      b. Steel beams through gypsum board walls; wall ratings as indicated on Drawings.
   2. Wall to Roof Joint Systems:
      a. Gypsum board walls to steel roof decks; wall ratings as indicated on Drawings.
B. Firestopping Locations/Types:
1. Exposed-To-View Locations: Elastomeric sealant and dam material.
2. Concealed-From-View Locations: Elastomeric spray and dam material.

END OF SECTION
SECTION 07 92 00

JOINT SEALANTS

1. PART 1  GENERAL

1.1  SUMMARY

A.  Section Includes:
   1.  Sealants and joint backing,
   2.  Accessories.

B.  Related Requirements:
   1.  Section 07 84 00 - Firestopping: Firestopping sealants.
   2.  Section 09260 - Gypsum Board Systems: Acoustic sealant.
   4.  Division 22 - Plumbing: Sealants and firestopping sealants required in conjunction with plumbing work.
   6.  Division 26 - Electrical: Sealants and firestopping sealants required in conjunction with electrical work.

1.2  REFERENCE STANDARDS

A.  ASTM International:

1.3  SUBMITTALS

A.  Section 01 33 00 - Submittal Procedures: Submittal procedures.

B.  Product Data: Submit data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.
C. **Samples:** Submit two sets of samples for Architect/Engineer's selection of sealant colors.

### 1.4 CLOSEOUT SUBMITTALS

A. **Section 01 70 00 - Execution and Closeout Requirements:** Closeout submittals.

B. **Warranty:** Submit manufacturer’s warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

### 1.5 QUALIFICATIONS

A. **Manufacturer:** Company specializing in manufacturing Products specified in this Section.

B. **Applicator:** Company specializing in performing Work of this Section.

### 1.6 ENVIRONMENTAL REQUIREMENTS

A. **Section 01 60 00 - Product Requirements.**

B. Maintain temperature and humidity recommended by sealant manufacturer during and after installation.

### 1.7 COORDINATION

A. **Section 01 30 00 - Administrative Requirements:** Coordination and project conditions.

B. Coordinate Work with sections referencing this section.
2. PART 2 PRODUCTS

2.1 JOINT SEALANTS

A. Manufacturers - Sealant Type A:
   1. BASF Construction Chemicals, LLC.
   2. Pecora Corporation.
   3. Sika Corporation, USA.
   4. Tremco, Inc.
   5. Substitutions: Section 01 60 00 - Product Requirements.

B. Manufacturers - Sealant Type B:
   1. Dow Corning Corporation.
   2. GE Silicones.
   3. Pecora Corporation.
   4. Tremco, Inc.
   5. Substitutions: Section 01 60 00 - Product Requirements.

C. Product Description:
   1. General Purpose Interior Sealant (Sealant Type A): Acrylic emulsion latex; ASTM C834, single component, paintable.
      a. Colors: White for painted surfaces; colors as selected for non-painted surfaces.
      b. Applications: Use for:
         1) Interior wall and ceiling control joints.
         2) Joints between door and window frames and wall surfaces.
         3) Other interior joints for which no other type of sealant is indicated.
   2. Bathtub/Tile Sealant (Sealant Type B): White silicone; ASTM C920, Uses M and A; single component, mildew resistant.
      a. Applications: Use for:
         1) Joints between plumbing fixtures and floor and wall surfaces.
         2) Joints between countertops and wall surfaces.

2.2 ACCESSORIES

A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
3. C. Joint Backing: Round foam rod compatible with sealant; ASTM D1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.

D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

3. PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify substrate surfaces and joint openings are ready to receive Work.

C. Verify joint backing and release tapes are compatible with sealant.

3.2 PREPARATION

A. Remove loose materials and foreign matter impairing adhesion of sealant.

B. Clean and prime joints.

C. Perform preparation in accordance with ASTM C1193.

D. Protect elements surrounding Work of this Section from damage or disfiguration.

3.3 INSTALLATION

A. Perform installation in accordance with ASTM C1193.

B. Measure joint dimensions and size joint backers to achieve the following, unless otherwise indicated;
   2. Neck dimension no greater than 1/3 of joint width.
   3. Surface bond area on each side not less than 75 percent of joint width.
C. Install bond breaker where joint backing is not used.

D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.

E. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

F. Tool joints concave.

3.4 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Clean adjacent soiled surfaces.

3.5 PROTECTION OF INSTALLED WORK

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed work.

B. Protect sealants until cured.

END OF SECTION
SECTION 08 12 13.13

STANDARD HOLLOW METAL FRAMES

1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fire rated and non-rated hollow metal frames.
      a. Provide frames for interior cased openings.

B. Related Requirements:
   1. Section 04 20 00 - Unit Masonry: Placement of anchors into masonry wall construction and masonry grout fill of metal frames in non-rated masonry walls.
   2. Section 08 14 16 - Flush Wood Doors.
   3. Section 08 71 00 - Door Hardware: Hardware and gasketing.
   4. Section 08 80 00 - Glazing.
   5. Section 09 21 16 - Gypsum Board Assemblies: Joint compound mudding at frame anchors in gypsum board walls.
   6. Section 09 90 00 - Painting and Coating: Field painting of frames.

1.2 REFERENCE STANDARDS

A. American National Standards Institute:
   1. ANSI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
   2. ANSI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.

B. National Fire Protection Association:

C. Underwriters Laboratories, Inc.:
   1. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate frame elevations, reinforcement, anchor types and spacing, location of cut-outs for hardware, and finish.

C. Product Data: Submit frame configuration and finishes.

1.4 QUALITY ASSURANCE

A. Conform to requirements of ANSI A250.8.

B. Fire Rated Frame Construction: Conform with the following:
   1. UL 10C.

C. Installed Fire Rated Frame Assembly: Conform to NFPA 80 for fire rated class same as fire door.

D. Attach label from agency approved by authority having jurisdiction to identify each fire rated door frame.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section.

B. Supplier: Company specializing in supplying Products specified in this Section.

C. Installer: Company specializing in performing Work of this Section.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Accept frames on site in manufacturer's packaging. Inspect for damage.

C. Break seal on-site to permit ventilation.
1.7 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate Work with frame opening construction, door, and hardware installation.

2. PART 2 PRODUCTS

2.1 HOLLOW METAL FRAMES

A. Manufacturers:
   1. Amweld Building Products; Division of Black Mountain Door.
   2. Ceco Door.
   3. Curries Company.
   5. Republic Hollow Metal.
   7. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: Standard shop fabricated hollow metal frames, fire rated and non-rated types.
   1. Interior Frames:
      a. Level 2 for Door Model 2, nominal 16 gage/0.053 inch thick material, base metal thickness.

2.2 ACCESSORIES

A. Removable Stops: Rolled steel channel shape, butted corners; prepared for countersink style screws.

B. Primer: ANSI A250.10 rust inhibitive type.

C. Anchors:
   1. Masonry Tee Anchor: 16 gage, ‘T’ shaped, ‘T’ formed to frame profile, leg punched or corrugated; adjustable; 10 inches long minimum.
   2. Existing Masonry Anchor: 16 gage, formed to frame profile, weld to frame, provide provisions for anchoring to existing masonry. Include countersunk, flathead expansion bolts.
3. Steel Stud Anchor: 16 gage, formed to frame profile with stud flange, weld to frame, provide provisions for anchoring to studs.

4. Adjustable Base Anchor: 16 gage, two-piece assembly; anchor plate formed to frame profile, welded to frame; floor flange, adjustable, provide provisions for anchoring to floor. Provide non-standard floor flange height as required.

2.3 FABRICATION

A. Fabricate frames as fully welded units, with face, rabbet, and soffit seams continuous welded, ground, and finished smooth.

B. Fabricate frames with hardware reinforcement plates welded in place for hinges, rim exit devices, closers, and strikes. Provide mortar guard boxes.

C. Configure interior frames without rabbets at cased openings where indicated.

D. Prepare frames for silencers. Provide three holes for single doors on strike side.

E. Prepare frame for removable glazing stops. Interior frames to have removable stops on secure side of door.

F. Clip at head of each mullion.

G. Emboss stamp or attach fire rated and positive pressure label to each fire rated frame.

2.4 SHOP FINISHING

A. Primer: Baked.
3. PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify opening sizes and tolerances are acceptable.

3.2 PREPARATION

A. Field coat inside of frame profile with bituminous coating to minimum thickness of 1/16 inch for interior non-rated frames in contact with cementitious materials.

3.3 INSTALLATION

A. Install frames in accordance with ANSI A250.8.

B. Coordinate with masonry wall construction for masonry tee anchor placement and grouting of metal frames specified in Section 04 05 03.

C. Coordinate with gypsum board wall construction for steel stud anchor placement and spot mudding of steel stud anchors specified in Section 09 21 16.

D. Coordinate installation of glass and glazing specified in Section 08 80 00.

E. Coordinate installation of frames with installation of hardware specified in Section 08 71 00 and doors in Section 08 14 16.

3.4 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Diagonal Distortion: 1/16 inch measured with straight edges, crossed corner to corner.
3.5 SCHEDULE

A. Standard Hollow Metal Frames:
   1. Refer to Door and Frame Schedule indicated on Drawings.

END OF SECTION
SECTION 08 14 16

FLUSH WOOD DOORS

1. PART 1  GENERAL

1.1  SUMMARY

A. Section Includes:
   1. Fire rated and non-rated flush wood doors

B. Related Requirements:
   1. Section 08 12 13.13 - Standard Hollow Metal Frames.
   2. Section 08 71 00 - Door Hardware.
   3. Section 08 80 - Glazing: Glazing for wood doors.
   4. Section 09 90 00 - Painting and Coating: Site finishing of wood doors.

1.2  REFERENCE STANDARDS

A. Architectural Woodwork Institute:
   1. AWI AWS - Architectural Woodwork Standards.

B. National Fire Protection Association:

C. Underwriters Laboratories, Inc.
   1. UL 10C - Positive Pressure Fire Tests of Door Assemblies.

D. Wood Window and Door Manufacturers Association:
   1. WDMA I.S. 1A - Architectural Wood Flush Doors.

1.3  COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate Work with door opening construction, door frame, and door hardware installation.
1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings:
   1. Indicate door opening criteria, elevations, sizes, types, swings, undercuts required, special beveling, special blocking for hardware, and factory machining criteria.

C. Product Data:
   1. Submit data for door core materials and construction.
   2. Submit data for veneer species, type and characteristics.
   3. Submit data for site finishing.

D. Samples:
   1. Submit two samples of door construction, 6 x 6 inches in size cut from top corner of door illustrating core, veneer, and edge trim.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout submittals.

B. Warranty: Submit manufacturer’s warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with AWI AWS Section 9, Custom Grade.

B. Fire Rated Door Construction: Conform to the following:
   1. UL 10C.

C. Installed Fire Rated Door Assembly: Conform to NFPA 80 for fire rated class as indicated on Drawings.

D. Attach label from agency approved by authority having jurisdiction to identify each fire rated door.
1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section.

B. Supplier: Company specializing in supplying Products specified in this Section.

C. Installer: Company specializing in performing Work of this Section.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Package, deliver and store doors in accordance with AWI AWS Section 2.

1.9 WARRANTY

A. Section 01 70 00 - Contract Closeout: Product warranties and product bonds.

B. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing of core construction.

C. Interior Doors: Furnish manufacturer’s life of installation warranty. For warranty repair work, remove and replace defective doors including machining, fitting, hanging, and finishing replacement doors.
2. PART 2 PRODUCTS

2.1 FLUSH WOOD DOORS

A. Manufacturers:
   1. Eggers Industries.
   2. Graham Wood Doors.
   3. Lambton Doors.
   4. Masonite.
   5. Oshkosh Architectural Door Company.
   7. Substitutions: Section 01 60 00 - Product Requirements.

B. Flush Interior Doors: Solid core.
   2. Core: PC.
   3. Stiles and Rails: SCL.
   5. Vertical Edges: Matching.
   7. Quality Grade: Custom.

C. Performance / Design Criteria:
   1. Performance Duty Level: WDMA I.S. 1A.
   2. Fire Resistance: As indicated on Drawings.

2.2 MATERIALS

A. Door Cores: AWI AWS Section 9.
   1. Solid Core, Non-Fire Rated:
      a. Type PC; particleboard.
   2. Solid Core, Fire Rated: Category A for positive pressure fire test.
      a. Type PC; particleboard.

B. Interior Door Faces:
   1. Transparent Finished Faces: Wood veneer.
      a. Species: Red Oak.
      b. Veneer Cut: Plain sliced.
      c. Veneer Matching: Book matched.
      d. Face Matching: Balanced.
C. Cross Banding Behind Veneer Finish: One ply; manufacturer’s standard construction.

D. Facing Adhesive: Type I - waterproof.

2.3 FABRICATION

A. Fabricate doors in accordance with AWI AWS Section 9 requirements.

B. Furnish lock blocks at lock edge and top of door for closer for hardware reinforcement.

C. Vertical Exposed Edge of Stiles: Hardwood lumber matching door facing; edge-before-face construction; finished to match door facings.

D. Fit door edge trim to edge of stiles after applying veneer facing.

E. Bond edge banding to cores.

F. Factory machine doors for finish hardware in accordance with hardware requirements and dimensions. Do not machine for surface hardware. Furnish solid blocking for through bolted hardware.

G. Factory fit doors for frame opening dimensions identified on shop drawings.

H. Provide edge clearances in accordance with AWI AWS Section 9.

2.4 ACCESSORIES

A. Door Glazing:
   1. Glass: As specified in Section 08 80 00.
   2. Glazing Stops: Rolled steel, two piece, mitered corners; prepared for countersunk style screws; manufacturer’s standard prime paint finish.
3. PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.2 INSTALLATION

A. Install doors in accordance with AWI AWS Section 9 and manufacturer's instructions.

B. Coordinate installation of doors with installation of frames specified in Section 08 12 13.13 and hardware specified in Section 08 71 00.

C. Coordinate installation of glass and glazing specified in Section 08 80 00.

3.3 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Conform to AWI AWS Section 9 requirements for the following:
   1. Fit and clearance tolerances.
   2. Gaps.
   3. Flushness.
   4. Flatness.
   5. Squareness.

3.4 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.

B. Adjust door for smooth and balanced door movement.

C. Adjust door closer for full closure.
3.5 SCHEDULE

A. Flush Wood Doors:
   1. Refer to Door and Frame Schedule indicated on Drawings.

END OF SECTION
SECTION 08 31 13
ACCESS DOORS AND FRAMES

1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Non-rated access doors with frames.

1.2 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit literature indicating sizes, types, finishes, hardware, scheduled locations, and details of adjoining Work.

1.3 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout submittals.

B. Project Record Documents: Record actual locations of access units.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section.
2. PART 2 PRODUCTS

2.1 ACCESS DOORS AND FRAMES

A. Manufacturers - Wall Units:
   2. Other Acceptable Manufacturers:
      a. JL Industries, Incorporated.
      c. MIFAB.
   3. Substitutions: Section 01 60 00 - Product Requirements.

B. Flush Framed Access Doors: Frames and nominal 1 inch wide exposed flanges of 16 gage stainless steel and door panels of 16 gage stainless steel.

2.2 FABRICATION

A. Fabricate units of continuous welded construction; weld, fill, and grind joints to assure flush and square unit.

B. Wall Access Door and Frame Hardware:
   1. Hinge: Standard continuous or concealed spring pin type, 175 degree steel hinges.
   2. Lock: Cylinder lock with latch, two keys for each unit.

2.3 SHOP FINISHING

A. Stainless Steel: No. 4 finish.

3. PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify rough openings for doors and frames are correctly sized and located.
3.2 INSTALLATION

A. Secure frames rigidly in place, plumb and level in opening, with plane of door and panel face aligned with adjacent finished surfaces.

B. Position unit to provide convenient access to concealed Work requiring access.

3.3 SCHEDULE

A. Access Doors and Frames:
   1. Restroom Walls: MS3202-660; non-rated, universal wall type; 16 x 16 inch size, stainless steel; cylinder lock, anchors.

END OF SECTION
1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fire rated and non-rated overhead coiling doors, operating hardware, manual operation.

B. Related Sections:
   1. Division 28 - Electronic Safety and Security: Electrical characteristics and wiring connections, including local fire detectors.

1.2 REFERENCE STANDARDS

A. ASTM International:
   1. ASTM A666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

B. Intertek Testing Services (Warnock Hersey Listed);
   1. WH - Certification Listings.

C. National Fire Protection Association:

D. Underwriters Laboratories Inc.:
   1. UL - Building Materials Directory.
   2. UL 10B - Fire Tests of Door Assemblies.

1.3 SYSTEM DESCRIPTION

B. Fire Rated Assemblies: Fire rated door, fire release device activated by fusible link and local smoke/heat detectors with automatic governed closing speed.
   1. Design release mechanism for easy resetting by facility maintenance personnel.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.

C. Product Data: Submit general construction, component connections, and details.

D. Samples: Submit two door slats, 6 inches in length illustrating shape, color and finish texture.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout submittals.

B. Operation and Maintenance Data: Submit lubrication requirements and frequency, and periodic adjustments required.

1.6 QUALITY ASSURANCE

A. Fire Rated Door Construction: Conform to one of the following:
   1. NFPA 252.
   2. UL 10B.

B. Attach label from agency approved by authority having jurisdiction to identify each fire rated door.

C. Installed Fire Rated Door Assembly: Conform to NFPA 80 for fire rated class as indicated on Drawings.

D. Products Requiring Electrical Connection: Listed and classified by UL or another testing firm acceptable to authority having jurisdiction.
1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section.

B. Installer: Company specializing in performing Work of this Section.

1.8 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate Work with location and placement of utilities. Coordinate characteristics of utilities with requirements for overhead coiling doors.

C. Sequence installation to accommodate required utility connections.

2. PART 2 PRODUCTS

2.1 OVERHEAD COILING DOORS

A. Manufacturers:
   2. Other Acceptable Manufacturers:
      a. Atlas Door.
      b. The Cookson Company.
      c. Overhead Door Corporation.
   3. Substitutions: Section 01 60 00 - Product Requirements.

2.2 COMPONENTS

A. Curtain: Conform to following; fire rated in accordance with requirements Scheduled:
   1. Stainless Steel Slats: Interlocking, minimum 22 gage of stainless steel conforming to ASTM A666 Type 304 rollable temper.
      a. Type: Single thickness flat slat.
   2. Nominal Slat Size: 1-1/2 inches wide by required length.
   3. Slat Ends: Alternate slats fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
4. Curtain Bottom: Fitted with angles, channels, or tubes to provide reinforcement and positive contact with counter in closed position.

B. Guides: Minimum 3/16 inch thick; stainless steel conforming to ASTM A666 Type 304 rollable temper.  
   1. Furnish continuous angles of profile to retain door in place, with snap-on trim; mounting brackets of same metal.

C. Roller Shaft Counterbalance: Steel pipe and helical steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension.

D. Hood Enclosure: Square shape, minimum 24 gage stainless steel; internally reinforced to maintain rigidity and shape.

E. Hardware:  
   1. Handle: Inside center mounted, adjustable keeper, spring activated latch bar with feature to keep in locked or retracted position; interior handle.  
   2. Smoke Seals: Perimeter gaskets and closures to prevent spread of smoke through door assembly and to maintain required fire rating and fire label.

F. Fire Release Device: Electro-mechanical solenoid release device, fusible link and remote smoke/heat detector activated; normally energized, release when de-energized, adjustable time delay.

G. Plastic Laminate Counter Sill: 1-1/2 hour UL labeled, plastic laminate bonded to non-combustible core, color as Scheduled.


2.3 SHOP FINISHING

A. Curtain Slats, Guides, and Hood Enclosure: Stainless steel, NAAMM No. 4 satin directional polished finish.
3. PART 3 EXECUTION

3.1 EXAMINATION
A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
B. Verify opening sizes, tolerances and conditions are acceptable.

3.2 INSTALLATION
A. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
B. Securely and rigidly brace components suspended from structure.
C. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
D. Install fire rated door assemblies in accordance with NFPA 80 and requirements for fire listing.
E. Sequence installation to accommodate required utility connections.
F. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07 92 00.
G. Install perimeter trim and closures.

3.3 ERECTION TOLERANCES
A. Section 01 40 00 - Quality Requirements: Tolerances.
B. Maintain dimensional tolerances and alignment with adjacent Work.
C. Maximum Variation From Plumb: 1/16 inch.
D. Maximum Variation From Level: 1/16 inch.
E. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 foot straight edge.
3.4 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Adjust door, hardware, and operating assemblies for smooth and noiseless operation.

C. Test smoke activated assemblies for proper activation.

3.5 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Clean door and components.

C. Remove labels and visible markings.

3.6 SCHEDULE

A. Overhead Coiling Doors:
   1. Student Store 116 (Door 116-2):
      a. Model: ESC10 rolling counter door with #1F (1-1/2") stainless steel slats, guides, and hood.
      b. Mounting: Face of wall.
      c. Label: Non-rated.
      e. Size: As indicated on Drawings.
      f. Counter: UL labeled plastic laminate sill.
2. Student Store 116 (Door 116-3):
   a. Model: ERC10 rolling counter door with #1F (1-1/2") stainless steel slats, guides, and hood; smoke seals at guides, head, and bottom bar.
   b. Mounting: Face of wall.
   c. Label: 45 minute rated.
   d. Operation: Manual push-up, SS90-B fire release device.
   e. Size: As indicated on Drawings.
   f. Counter: UL labeled plastic laminate sill.

END OF SECTION
SECTION 08 71 00

DOOR HARDWARE

1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Hardware for wood doors.
   2. Door gaskets.

B. Related Requirements:
   1. Section 01 11 00 - Summary of Work: Access control system by Owner’s separate contractor, including card readers, motion detectors, and door contacts.
   2. Section 08 12 13.13 - Standard Hollow Metal Frames.
   3. Section 08 14 16 - Flush Wood Doors
   4. Section 08 31 13 - Access Doors and Frames: Door hardware.
   6. Division 26 - Electrical: Electrical characteristics and wiring connections, including installation of EL exit device power supplies specified in this section.

1.2 REFERENCE STANDARDS

A. American National Standards Institute:
   1. ANSI A156.1 - Butts and Hinges.
   2. ANSI A156.2 - Locks and Latches.
   3. ANSI A156.3 - Exit Devices.
   4. ANSI A156.4 - Door Controls - Closers.
   5. ANSI A156.5 - Cylinders and Input Devices for Locks.
   6. ANSI A156.6 - Architectural Door Trim.
   7. ANSI A156.8 - Overhead Stops and Holders.
   8. ANSI A156.16 - Auxiliary Hardware.
   9. ANSI A156.18 - Materials and Finishes.
   10. ANSI A156 - Complete Set of 24 BHMA Standards (A156 Series) with Binder.
B. Builders Hardware Manufacturers Associations:
   1. BHMA Directory of Certified Products.

C. Door and Hardware Institute:
   1. DHI - Sequence and Format for Schedules.

D. National Fire Protection Association:

E. Underwriters Laboratories Inc.:
   1. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
   2. UL 305 - Panic Hardware.

F. Intertek Testing Services (Warnock Hersey Listed):
   1. WH - Certification Listings.

1.3 PERFORMANCE REQUIREMENTS

A. Fire Rated Openings: Provide door hardware listed by UL or Intertek Testing Services (Warnock Hersey Listed), or other testing laboratory approved by authorities having jurisdiction.
   1. Hardware: Tested in accordance with UL 10C.

B. Panic and Fire Exit Devices: Provide exit devices meeting the following requirements:
   1. Exit devices shall be provided by one manufacturer.
   2. Function of device shall be able to be changed on site at Owner discretion, by replacement of exterior trim; no other conversion parts shall be required.
   3. Standard non-electric devices shall be able to be converted to electric operation by replacement of base assembly only.
1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings:
   1. Submit hardware schedule organized into hardware sets in vertical format in accordance with DHI, indicating complete designations of every item required for each door or openings. Include the following:
      a. Type, style, function, size and finish of each hardware item.
      b. Name and manufacturer of each item.
      c. Fastenings and other pertinent information.
      d. Location of hardware set cross-referenced to indications on Drawings both on floor plans, in door and frame schedule, or specifications.
      e. Explanation of all abbreviations, symbols, codes, etc. contained in schedule.
      f. Mounting locations for hardware.
      g. Electrical characteristics and connection requirements for hardware. Include wiring diagrams prepared by factory authorized personnel, indicating exact point to point connections. Provide elevation sheets indicating conduit runs for each door receiving electrified hardware. Provide brief written explanation indicating how components go together as system. If there is an interface required with another electrical system (ie: access control system), requirements of hardware system shall be defined by the hardware supplier.
         1) Wiring diagrams shall be submitted at time hardware shop drawings and product data are submitted; if wiring diagrams are not submitted at same time, hardware shop drawings and product data will not be reviewed until they are submitted.
      h. Door and frame sizes and materials.
      i. Submit manufacturer's parts lists and templates.

C. Product Data: Provide data sheets and catalog cuts on hardware components, sizes, features, and finishes.

D. Supplier Qualifications: Submit written qualifications documenting Architectural Hardware Consultant’s (AHC) credential number.
1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout submittals.

B. Project Record Documents: Record actual locations of installed cylinders and their master key code.

C. Hardware Supplier Certificate: Submit written certification that Products have been installed in accordance with manufacturer's installation instructions, have been properly adjusted for intended use, and operate smoothly. Provide form included at end of this section.

D. Operation and Maintenance Data: Submit data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

E. Keys: Deliver with identifying tags to Owner by security shipment direct from hardware supplier.

F. Warranty: Submit manufacturer’s warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Perform work in accordance with the following requirements:
   1. ANSI A156 Series.
   2. NFPA 80.
   3. UL 305.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section.

B. Hardware Supplier: Company specializing in supplying commercial specified in this Section. Supplier shall be, or employ a credentialed Architectural Hardware Consultant (AHC). Hardware Schedule shall be prepared and signed by AHC, or reviewed and signed by AHC if AHC is third-party employed by Supplier.
C. Installer: Company specializing in performing Work of this Section.

D. Products Requiring Electrical Connection: Listed and classified by Underwriters’ Laboratories, Inc., as suitable for purpose specified and indicated.

1.8 PRE-INSTALLATION MEETING

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing Work of this Section.

C. Include Contractor’s on-site superintendent, Contractor’s Project Manager, installer(s) responsible for installation of doors, frames, and hardware, installer(s) responsible for installation of electrical conduit, wiring, EL exit device power supplies, and final connections to electrified hardware; include hardware supplier and Owner’s access control representative.

D. Review project requirements, substrate conditions, manufacturer’s installation instructions, manufacturer’s point-to-point wiring diagrams, and manufacturer’s warranty requirements.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Package hardware items individually with necessary fasteners, instructions, and installation templates, when necessary; label and identify each package with door opening code to match hardware schedule.
1.10 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate Work with other directly affected sections involving manufacture or fabrication of internal reinforcement for door hardware and recessed items.
   1. Provide templates or actual hardware as required to ensure proper preparation of doors and frames.

C. Coordinate Work with location and placement of utilities. Coordinate characteristics of utilities with requirements of electric door hardware and Owner’s access control components.

D. Sequence installation to accommodate required utility connections.

E. Coordinate Owner's keying requirements during course of Work. Upon return of reviewed finish hardware schedule, arrange meeting between Owner, hardware supplier, and other involved parties to establish keying schedule based on Project requirements.

1.11 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Warranties:
   1. Provide ten year manufacturer warranty for door closers.
   2. Provide three year manufacturer warranty for locks and exit devices.
   3. Provide one year manufacturer warranty for all other door hardware.

1.12 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish extra material as Scheduled.
2. PART 2 PRODUCTS

2.1 DOOR HARDWARE

A. Manufacturers:

1. Butt Hinge Manufacturers:
   a. Reference Manufacturer: Stanley.
   b. Other Acceptable Manufacturers:
      1) Bommer.
      2) Hager.
      3) Ives.
      4) Lawrence.
      5) McKinney.

2. Overhead Stop Manufacturers:
   a. Reference Manufacturer: Glynn-Johnson.
   b. Other Acceptable Manufacturers:
      1) AHB Manufacturing.
      2) The Dorma Group.
      3) Rixson.
      4) Sargent.

3. Bored Lock and Cylinder Manufacturer:
   a. Schlage: No substitutions.

4. Panic and Fire Exit Device Manufacturer:
   a. Von Duprin: No substitutions.

5. Door Closer Manufacturer:
   a. LCN: No substitutions.

6. Protection Plate Manufacturers:
   a. Reference Manufacturer: Rockwood.
   b. Other Acceptable Manufacturers:
      1) Brookline.
      2) Burns.
      3) Hager.
      4) Hiawatha, Inc.
      5) Ives.
      6) Trimco.

7. Smoke Seal Manufacturers:
   a. Reference Manufacturer: Reese.
   b. Other Acceptable Manufacturers:
      1) National Guard Products.
      2) Pemko.
      3) Zero.
8. Sound Seal Manufacturers:
   a. Reference Manufacturer: Reese.
   b. Other Acceptable Manufacturers:
      1) National Guard Products.
      2) Pemko.
      3) Zero.

9. Intumescent Seal Manufacturers:
   a. Reference Manufacturer: Pemko.
   b. Other Acceptable Manufacturers:
      1) Hager.
      2) Reese.

10. Automatic Door Bottom Manufacturers:
    a. Reference Manufacturer: Pemko.

11. Door Stop Manufacturers:
    a. Reference Manufacturer: Rockwood.
    b. Other Acceptable Manufacturers:
       1) Burns.
       2) Hager.
       3) Ives.
       4) Trimco.

12. Silencer Manufacturers:
    a. Reference Manufacturer: Rockwood.
    b. Other Acceptable Manufacturers:
       1) Burns.
       2) Hager.
       3) Ives.

13. Power Supply Manufacturer:
    a. Von Duprin: No substitutions.

14. Electric Power Transfer Manufacturer:
    a. Von Duprin: No substitutions.

15. Wiring Harness Manufacturer:
    a. Allegion: No substitutions.

16. Card Readers, Door Contacts, and Motion Detectors:
    Provided by Owners separate access control Contractor.

17. Substitutions: Section 01 60 00 - Product Requirements.
2.2 COMPONENTS

A. General Hardware Requirements: Where not specifically indicated, comply with ANSI A156 standard for type of hardware required. Provide each type of hardware with accessories as required for applications indicated and for complete, finished, operational doors.

1. Templates: Furnish templates or physical hardware items to door and frame manufacturers sufficiently in advance to avoid delay in Work.

2. Reinforcing Units: Furnished by door and frame manufacturers; coordinated by hardware supplier or hardware manufacturer.

3. Fasteners: Furnish as recommended by hardware manufacturer and as required to secure hardware.
   a. Finish: Match hardware item being fastened.

4. Fire Ratings: Provide hardware with UL or Intertek Testing Services (Warnock Hersey Listed) listings for type of application involved.

5. Positive Pressure Ratings: Provide hardware with UL listings for type of application involved.

6. Electrical Devices: Make provisions and coordinate requirements for electrical devices and connections for hardware.

B. Butt Hinges: ANSI A156.1, full mortise type complying with following general requirements unless otherwise Scheduled.

1. Widths: Sufficient to clear trim projection when door swings 180 degrees.

2. Number: Furnish minimum three hinges for each door leaf.

3. Size and Weight: 4-1/2 inch standard weight ball or oilite bearing hinges, typical for 1-3/4 inch doors. On heavy weight doors and high frequency openings furnish heavy weight hinges.
   a. Doors Over 40 Inches Wide: 5 inch heavy weight ball or oilite bearing hinges.


5. Tips: Flat button.

C. Overhead Stops: ANSI A156.8, Grade 1, types as Scheduled.
D. Bored (Cylindrical) Locks: ANSI A156.2, Series 4000, Grade 1 unless otherwise indicated; locations and functions as Scheduled.
   1. Furnish locks compatible with specified cylinders.
   3. Furnish vandal resistant levers where Scheduled.
   4. Furnish with indicator rose at classroom security function locks where Scheduled.
   5. Furnish standard strikes with extended lips to protect trim from being marred by latch bolt.

E. Cylinder Locks: Rim and mortise types, unless otherwise indicated.
   1. Types: Suitable for doors and hardware requiring cylinder locks.

F. Cylinders (of a lock): ANSI A156.5, Grade 1, 6 pin interchangeable core type cylinders.
   1. Keying: Key to existing District Schlage Patented (Everest) C123 Keyway; confirm keyway with Owner. Keyed as directed by Owner. Keyed in like-groups. Grand master keyed.
   2. Include permanent interchangeable cores keyed and ready for installation by Contractor. Construction keying and temporary construction cores not required.
   4. Supply keys in the following minimum quantities:
      a. 3 keys for each lock.
      b. 5 grand master keys.

G. Panic and Fire Exit Devices: ANSI A156.3, Grade 1, panic and fire rated types; EL (electric latch retraction) rim type, and rim type, with push pad and exterior trim unless otherwise indicated. Furnish standard strikes with extended lips to protect trim from being marred by latch bolt.
   1. Types: Suitable for doors requiring exit devices.
   2. Exterior Trim: Furnish with vandal resistant levers.
   3. Furnish with security indicator at classroom security exit devices where Scheduled.
   4. Glass Bead Kits: Furnish glass bead kits for use on doors with raised glass beads; shims to be metal, finished to match exist devices.
5. EL (electric latch retraction) Exit Device:
   a. Electrical: 24 VDC continuous duty, 16 amp current
      inrush, 0.3 amp current holding.
   b. Furnish EL exit devices (EL Exit Device Model - CON)
      with end connectors to connect to separate wiring
      harnesses from EL exit device to electric power
      transfer where Scheduled.
   c. Request-To-Exit (RX): Provide request-to-exit feature
      to signal use of opening; request-to-exit device to be
      equipped with one internal SPDT switch to monitor
      pushpad; factory installed.

H. Closers: ANSI A156.4, modern type with cover, surface mounted
   closers; full rack and pinion type with steel spring and all-weather
   hydraulic fluid capable of operating in temperatures ranging from -
   30 to 120 degrees F without valve adjustment. Closers required for
   fire/smoke rated doors unless otherwise indicated.
1. Adjustability: Provide controls for regulating closing, latching,
   speeds, and back checking.
2. Arms: Type to suit individual condition; parallel-arm closers
   at reverse bevel doors and where doors can swing full 180
   degrees.
3. Location: Mount closers on inside room side of interior doors
   typical; mount on pull side of other doors.
4. Operating Pressure: Maximum operating pressure as
   follows:
   a. Interior Doors: Maximum 5 pounds.
   b. Fire Rated Doors: As required for fire rating,
      maximum 15 pounds.

I. Protection Plates: Furnish as indicated in Schedule, with
   accessories as required for complete installation.
1. Kickplates: ANSI A156.6, metal; height indicated in
   Schedule by 2 inches less than door width for push side
   mounted kickplates, or 1-1/2 inches less than door width for
   pull side mounted kickplates.; minimum 0.050 inch thick
   stainless steel. Furnish plates with countersunk holes,
   beveled edges on four sides, and self-drilling screws.
J. Gasketing: Furnish as indicated in Schedule, with accessories as required for complete installation.
   1. Smoke Seals: Polyprene self-adhering strip; tear-drop shaped; fire rated type at fire/smoke rated doors where Scheduled. Furnish continuous smoke seals at top and sides of fire/smoke rated wood doors.
   2. Intumescent Seals: Graphite self-adhering strip; flat, rectangular profile; fire/smoke type at fire/smoke rated doors where Scheduled. Furnish continuous intumescent seals at top and sides (WH-Category B) of 20 minute fire rated wood doors.

K. Sound Gasketing: Furnish as indicated in Schedule, with accessories as required for complete installation.
   1. Sound Seals: Sponge neoprene set in aluminum retainer. Furnish continuous sound seals at tops and sides of sound doors.
   2. Automatic Door Bottoms: Sponge neoprene set in adjustable aluminum housing; semi-mortise at wood doors. Furnish continuous automatic door bottoms at bottoms of sound doors.

L. Door Stops: Furnish as indicated in Schedule, with accessories as required for complete installation.
   1. Wall Stops: ANSI A156.16, Grade 1, 2-1/2 inch wall stop, convex pad wall stop, concave pad wall stop with no visible screws.
   2. Floor Stops: ANSI A156.16, Grade 1, dome type; provide with accessories as required for applications indicated.

M. Miscellaneous Hardware: Furnish as indicated in Schedule, with accessories as required for complete installation.
   1. Silencers: ANSI A156.16, resilient rubber; push-in type.

N. Electrified Hardware: Furnish as indicated in Schedule, with accessories as required for complete installation.
   1. Power Suppliers: Power supply designed for EL exit devices on single door applications without automatic door operators; output power field selectable, standard input power 120VAC @ 2 amps; steel enclosure, hinged cover.
2. Electric Power Transfer (EPT): Concealed type; pivoting hollow tube wireway secured to recessed door and frame pockets.
   a. Furnish electric power transfer (Electric Power Transfer Model - CON) with end connectors to connect to separate wiring harnesses from EL exit device, and from electric power transfer to power supply where Scheduled.

3. Wiring Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors. Connectors to plug directly to through-door wiring for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. At EL exit devices, provide connector for through-door electric locking devices and from electric power transfer to power supplies located above openings. Determine length required for each electric hardware component for door type, size, and construction; two required at EL exit device openings. Where wiring harness (P-pin ends) from electric power transfer to power supply exceed length required by more than 12 inches, cut wiring harness and field install required connector in accordance with manufacturer's recommendations; use connectors from CON-KITs furnished as extra materials.

2.3 ACCESSORIES

A. Lock Trim: Furnish levers with rose as Scheduled.
   1. Do not permit through bolts on solid wood core doors.

2.4 FINISHING

A. Finishes: ANSI A156.18; furnish following finishes except where otherwise indicated in Schedule:
   6. Closers: ALUM powder coated finish (BHMA 689).
8. Smoke Seals: Black.
10. Intumescent Seals: Graphite; field painted under Section 09 90 00.
15. Other Items: Furnish manufacturer’s standard finishes to match similar hardware types on same door, and maintain acceptable finish considering anticipated use.

3. PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify doors and frames are ready to receive door hardware and dimensions are as indicated on shop drawings.

C. Verify electric power is available to power operated devices and is of correct characteristics.

3.2 INSTALLATION

A. Coordinate mounting heights with door and frame manufacturers. Use templates provided by hardware item manufacturer.

B. Mounting Heights From Finished Floor to Center Line of Hardware Item: Comply with manufacturer recommendations and applicable codes where not otherwise indicated.
1. Locksets: 40 inch.
2. Push Pad Type Exit Devices: 41 inch.
3. Push Pad Type Dummy Exit Devices: 41 inch.
4. Hinges:
   a. Top Hinge: Jamb manufacturer’s standard, but not greater than 10 inches from head of frame to center line of hinge.
   b. Bottom Hinge: Jamb manufacturer’s standard, but not greater than 12-1/2 inches from floor to center line of hinge.
c. Intermediate Hinges: Equally spaced between top and bottom hinges and from each other.
d. Hinge Mortise on Door Leaf: 1/4 inch to 5/16 inch from stop side of door.

3.3 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Inspecting, testing, adjusting, and balancing.

B. Architectural Hardware Consultant shall inspect installation and certify hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

3.4 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Adjust hardware for smooth operation.

C. Six-Month Adjustment: Approximately six months after date of Substantial Completion, installer, accompanied by representatives of manufacturers of locksets, door control devices, and other major hardware suppliers shall return to Project to perform following:

1. Examine and re-adjust each item of door hardware as necessary to restore function of doors and hardware to comply with specified requirements.
2. Consult with, and instruct Owner's personnel in recommended additions to their maintenance procedures.
3. Replace hardware items that have deteriorated or failed due to faulty design, materials, or installation of hardware units.
4. Prepare written report of current and predictable problems of substantial nature in performance of hardware.

3.5 PROTECTION OF INSTALLED WORK

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed work.

B. Do not permit adjacent work to damage hardware or hardware finish.
3.6 HARDWARE SUPPLIERS CERTIFICATE

A. Signed by: Contractor and Hardware Installer (notarized).

B. From: 
________________________
________________________
________________________

C. To: Board of Education
   Ankeny Community School District

D. Project: Parkview MS Renovation & System Upgrades - Phase 2

The undersigned, Contractor and Hardware Supplier, hereby certify that they have jointly inspected door hardware on each door opening of the above referenced Project and that door hardware has been installed in accordance with the manufacturer’s installation instructions, has been properly adjusted for its intended use, and operates smoothly at time of inspection.

They further certify that the door hardware was inspected based on their review of the Contract Documents and the Hardware Suppliers door hardware shop drawings.

They further certify that the recommendations attached to this Certification were provided by the Hardware Supplier, to the Contractor, outlining corrective actions necessary to bring the door hardware into compliance with the Contract Documents. (Provide separate list of corrective Work including door numbers, deficiencies, and descriptions of corrective work required).

________________________  _________________________________
Contractor Hardware Supplier

________________________  _________________________________
Address Address

Date:___________________   Date:_____________________________
(Notarize)            (Notarize)
3.7 ABBREVIATIONS

A. Hardware Manufacturer's Abbreviations:

A - Allegion
GJ - Glynn-Johnson
L - LCN
P - Pemko
R - Reese
RW - Rockwood
SH - Stanley
V - Von Duprin

3.8 HARDWARE SCHEDULE

HARDWARE SET NUMBER 1

1 SINGLE INTERIOR DOOR - CLASSROOM
3'-0" x 7'-0" x 1-3/4" x WD x HMF x 20 MINUTE RATED

[Doors: 111, 112]

<table>
<thead>
<tr>
<th>Item</th>
<th>Qty</th>
<th>Description</th>
<th>Model/Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>SH</td>
<td>3 each</td>
<td>butt hinges</td>
<td>FBB168 x 4-1/2 x 4-1/2</td>
</tr>
<tr>
<td>SL</td>
<td>1 each</td>
<td>cyl classrm security lock</td>
<td>ND95PD x RHO</td>
</tr>
<tr>
<td>L</td>
<td>1 each</td>
<td>closer</td>
<td>P1461</td>
</tr>
<tr>
<td>RW</td>
<td>1 each</td>
<td>kickplate</td>
<td>K1050 x 8&quot; high</td>
</tr>
<tr>
<td>R</td>
<td>1 set</td>
<td>smoke seals</td>
<td>797</td>
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<tr>
<td>P</td>
<td>1 set</td>
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<td>HSS1000</td>
</tr>
<tr>
<td>RW</td>
<td>1 each</td>
<td>floor stop</td>
<td>441</td>
</tr>
</tbody>
</table>

HARDWARE SET NUMBER 2

1 SINGLE INTERIOR DOOR - TOILET
3'-0" x 7'-0" x 1-3/4" x WD x HMF x NON-RATED

[Door: 111A]

<table>
<thead>
<tr>
<th>Item</th>
<th>Qty</th>
<th>Description</th>
<th>Model/Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
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<td>butt hinges</td>
<td>FBB179 x 4-1/2 x 4-1/2</td>
</tr>
<tr>
<td>SL</td>
<td>1 each</td>
<td>cyl privacy lock</td>
<td>ND40S x RHO</td>
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<tr>
<td>RW</td>
<td>1 each</td>
<td>kickplate</td>
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</tr>
<tr>
<td>RW</td>
<td>1 each</td>
<td>floor stop</td>
<td>441</td>
</tr>
<tr>
<td>RW</td>
<td>3 each</td>
<td>silencers</td>
<td>608-RKW</td>
</tr>
</tbody>
</table>
HARDWARE SET NUMBER 3

1 SINGLE INTERIOR DOOR - CONTROLLED
3'-0" x 7'-0" x 1-3/4" x WD x HMF x NON-RATED

[Doors: 111B, 114C]

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Description</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>SH</td>
<td>3</td>
<td>butt hinges</td>
<td>FBB179 x 4-1/2 x 4-1/2</td>
</tr>
<tr>
<td>SL</td>
<td>1</td>
<td>cyl entrance lock</td>
<td>ND91PD x RHO</td>
</tr>
<tr>
<td>RW</td>
<td>1</td>
<td>kickplate</td>
<td>K1050 x 8&quot; high</td>
</tr>
<tr>
<td>RW</td>
<td>1</td>
<td>floor stop</td>
<td>441</td>
</tr>
<tr>
<td>RW</td>
<td>3</td>
<td>silencers</td>
<td>608-RKW</td>
</tr>
</tbody>
</table>

HARDWARE SET NUMBER 4

1 SINGLE INTERIOR DOOR - CONTROLLED
3'-0" x 7'-0" x 1-3/4" x WD x HMF x 20 MINUTE RATED

[Doors: 113, 114-2, 115A, 115B, 212A]

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Description</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>SH</td>
<td>3</td>
<td>butt hinges</td>
<td>FBB168 x 4-1/2 x 4-1/2</td>
</tr>
<tr>
<td>SL</td>
<td>1</td>
<td>cyl classroom security lock</td>
<td>ND95PD x RHO</td>
</tr>
<tr>
<td>L</td>
<td>1</td>
<td>closer</td>
<td>1461</td>
</tr>
<tr>
<td>RW</td>
<td>1</td>
<td>kickplate</td>
<td>K1050 x 8&quot; high</td>
</tr>
<tr>
<td>R</td>
<td>1</td>
<td>smoke seals</td>
<td>797</td>
</tr>
<tr>
<td>P</td>
<td>1</td>
<td>intumescent seals</td>
<td>HSS1000</td>
</tr>
<tr>
<td>RW</td>
<td>1</td>
<td>floor stop</td>
<td>441</td>
</tr>
</tbody>
</table>

HARDWARE SET NUMBER 5

1 SINGLE INTERIOR DOOR - ELECTRIC
3'-0" x 7'-0" x 1-3/4" x WD x HMF x NON-RATED

[Door: 113A]

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Description</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>SH</td>
<td>3</td>
<td>butt hinges</td>
<td>FBB179 x 4-1/2 x 4-1/2</td>
</tr>
<tr>
<td>SL</td>
<td>1</td>
<td>cyl storeroom lock</td>
<td>ND96PD x RHO</td>
</tr>
<tr>
<td>RW</td>
<td>1</td>
<td>kickplate</td>
<td>K1050 x 8&quot; high</td>
</tr>
<tr>
<td>RW</td>
<td>1</td>
<td>wall stop</td>
<td>402</td>
</tr>
<tr>
<td>RW</td>
<td>3</td>
<td>silencers</td>
<td>608-RKW</td>
</tr>
</tbody>
</table>
## HARDWARE SET NUMBER 6

1 SINGLE INTERIOR DOOR - SCHOOL OFFICE  
3'-0" x 7'-0" x 1-3/4" x WD x HMF x 20 MINUTE RATED  

[Door: 114-1]

<table>
<thead>
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<th>Description</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
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<td>butt hinges</td>
<td>FBB168 x 4-1/2 x 4-1/2</td>
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<tr>
<td>GJ</td>
<td>1 each</td>
<td>overhead stop</td>
<td>90S</td>
</tr>
<tr>
<td>V</td>
<td>1 each</td>
<td>exit device</td>
<td>99L-F-996L (Less cylinder)</td>
</tr>
<tr>
<td>SL</td>
<td>1 each</td>
<td>cylinder</td>
<td>Type required</td>
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<tr>
<td>L</td>
<td>1 each</td>
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<td>P1461</td>
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<tr>
<td>L</td>
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<td>RW</td>
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<td>R</td>
<td>1 set</td>
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<tr>
<td>P</td>
<td>1 set</td>
<td>intumescent seals</td>
<td>HSS1000</td>
</tr>
</tbody>
</table>

## HARDWARE SET NUMBER 7

1 SINGLE INTERIOR DOOR - HALL  
3'-0" x 7'-0" x 1-3/4" x WD x HMF x NON-RATED  

[Door: 114A]

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Description</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>SH</td>
<td>3 each</td>
<td>butt hinges</td>
<td>FBB168 x 4-1/2 x 4-1/2</td>
</tr>
<tr>
<td>V</td>
<td>1 each</td>
<td>EL exit device</td>
<td>EL-RX-SD-99L-996L-CON (Less cylinders)</td>
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<tr>
<td>SL</td>
<td>2 each</td>
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<td>Type required</td>
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<td>L</td>
<td>1 each</td>
<td>closer</td>
<td>P1461</td>
</tr>
<tr>
<td>RW</td>
<td>1 each</td>
<td>kickplate</td>
<td>K1050 x 8&quot; high</td>
</tr>
<tr>
<td>RW</td>
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<td>floor stop</td>
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<tr>
<td>RW</td>
<td>3 each</td>
<td>silencers</td>
<td>608-RKW</td>
</tr>
<tr>
<td>V</td>
<td>1 each</td>
<td>power supply</td>
<td>PS914 900-2RS</td>
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<td>V</td>
<td>1 each</td>
<td>power transfer</td>
<td>EPT-10-CON</td>
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<tr>
<td>A</td>
<td>1 each</td>
<td>wiring harness</td>
<td>CON-44</td>
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<tr>
<td>A</td>
<td>1 each</td>
<td>wiring harness</td>
<td>CON-192P</td>
</tr>
</tbody>
</table>

* Access control opening.  
* Access granted by presentation of credential at card reader and access control system.  
* Card reader, motion detector, and door contact provided by Others.
### HARDWARE SET NUMBER 8

1 SINGLE INTERIOR DOOR - CONTROLLED  
3'-0" x 7'-0" x 1-3/4" x WD x HMF x NON-RATED

[Doors: 114B, 116-1, 117, 124B, 169B]

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Description</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>SH</td>
<td>3 each</td>
<td>butt hinges</td>
<td>FBB179 x 4-1/2 x 4-1/2</td>
</tr>
<tr>
<td>SL</td>
<td>1 each</td>
<td>cyl classroom lock</td>
<td>ND94PD x RHO</td>
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<td>RW</td>
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</tr>
<tr>
<td>RW</td>
<td>1 each</td>
<td>floor stop</td>
<td>441</td>
</tr>
<tr>
<td>RW</td>
<td>3 each</td>
<td>silencers</td>
<td>608-RKW</td>
</tr>
</tbody>
</table>

### HARDWARE SET NUMBER 9

1 SINGLE INTERIOR DOOR - OFFICE  
3'-0" x 7'-0" x 1-3/4" x WD x HMF x NON-RATED

[Door: 114D]

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Description</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>SH</td>
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<td>butt hinges</td>
<td>FBB179 x 4-1/2 x 4-1/2</td>
</tr>
<tr>
<td>SL</td>
<td>1 each</td>
<td>cyl entrance lock</td>
<td>ND91PD x RHO</td>
</tr>
<tr>
<td>RW</td>
<td>1 each</td>
<td>kickplate</td>
<td>K1050 x 8&quot; high</td>
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<tr>
<td>RW</td>
<td>1 each</td>
<td>wall stop</td>
<td>405</td>
</tr>
<tr>
<td>RW</td>
<td>3 each</td>
<td>silencers</td>
<td>608-RKW</td>
</tr>
</tbody>
</table>

### HARDWARE SET NUMBER 10

1 SINGLE INTERIOR OVERHEAD COILING DOOR - STUDENT STORE  
2'-6" x 3'-8" x - x SS x SS x NON-RATED

[Door: 116-2]

* All hardware provided by overhead coiling door manufacturer.

### HARDWARE SET NUMBER 11

1 SINGLE INTERIOR OVERHEAD COILING DOOR - STUDENT STORE  
2'-6" x 3'-8" x - x SS x SS x 45 MINUTE RATED

[Door: 116-3]

* All hardware provided by overhead coiling door manufacturer.
**HARDWARE SET NUMBER 12**

**1 SINGLE INTERIOR DOOR - CONTROLLED**

3'-0" x 7'-0" x 1-3/4" x WD x HMF x NON-RATED

[Doors: 120A, 171A]

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SH</td>
<td>3 each</td>
<td>butt hinges</td>
<td>FBB179 x 4-1/2 x 4-1/2</td>
</tr>
<tr>
<td>SL</td>
<td>1 each</td>
<td>cyl classroom lock</td>
<td>ND94PD x RHO</td>
</tr>
<tr>
<td>RW</td>
<td>1 each</td>
<td>kickplate</td>
<td>K1050 x 8&quot; high</td>
</tr>
<tr>
<td>RW</td>
<td>1 each</td>
<td>wall stop</td>
<td>402</td>
</tr>
<tr>
<td>RW</td>
<td>3 each</td>
<td>silencers</td>
<td>608-RKW</td>
</tr>
</tbody>
</table>

**HARDWARE SET NUMBER 13**

**1 SINGLE INTERIOR DOOR - CONTROLLED**

3'-0" x 7'-0" x 1-3/4" x WD x HMF x NON-RATED

[Doors: 124, 169, 170]

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SH</td>
<td>3 each</td>
<td>butt hinges</td>
<td>FBB168 x 4-1/2 x 4-1/2</td>
</tr>
<tr>
<td>V</td>
<td>2 each</td>
<td>rim exit devices</td>
<td>99L-996L-2Si (Less cylinders)</td>
</tr>
<tr>
<td>SL</td>
<td>2 each</td>
<td>cylinders</td>
<td>Type required</td>
</tr>
<tr>
<td>L</td>
<td>1 each</td>
<td>closer</td>
<td>P1461</td>
</tr>
<tr>
<td>RW</td>
<td>1 each</td>
<td>kickplate</td>
<td>K1050 x 8&quot; high</td>
</tr>
<tr>
<td>RW</td>
<td>1 each</td>
<td>floor stop</td>
<td>441</td>
</tr>
<tr>
<td>RW</td>
<td>3 each</td>
<td>silencers</td>
<td>608-RKW</td>
</tr>
</tbody>
</table>

**HARDWARE SET NUMBER 14**

**1 SINGLE INTERIOR DOOR - CUSTODIAN**

4'-0" x 7'-0" x 1-3/4" x WD x HMF x 20 MINUTE RATED

[Door: 163]

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>SH</td>
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<td>butt hinges</td>
<td>FBB168 X 5 X 4-1/2</td>
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<tr>
<td>SL</td>
<td>1 each</td>
<td>cyl storeroom lock</td>
<td>ND96PD x RHO</td>
</tr>
<tr>
<td>L</td>
<td>1 each</td>
<td>closer</td>
<td>1461</td>
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<tr>
<td>RW</td>
<td>1 each</td>
<td>kickplate</td>
<td>K1050 x 8&quot; high</td>
</tr>
<tr>
<td>R</td>
<td>1 set</td>
<td>smoke seals</td>
<td>797</td>
</tr>
<tr>
<td>P</td>
<td>1 set</td>
<td>intumescent seals</td>
<td>HSS1000</td>
</tr>
<tr>
<td>RW</td>
<td>1 each</td>
<td>wall stop</td>
<td>402</td>
</tr>
</tbody>
</table>
### HARDWARE SET NUMBER 15

**1 SINGLE INTERIOR DOOR - OFFICE**  
3'-0" x 7'-0" x 1-3/4" x WD x HMF x NON-RATED

[Door: 166D]

<table>
<thead>
<tr>
<th>Item</th>
<th>Qty</th>
<th>Description</th>
<th>Model/Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>SH</td>
<td>3</td>
<td>butt hinges</td>
<td>FBB179 x 4-1/2 x 4-1/2</td>
</tr>
<tr>
<td>SL</td>
<td>1</td>
<td>cyl entrance lock</td>
<td>ND91PD x RHO</td>
</tr>
<tr>
<td>RW</td>
<td>1</td>
<td>kickplate</td>
<td>K1050 x 8&quot; high</td>
</tr>
<tr>
<td>R</td>
<td>1</td>
<td>sound seals</td>
<td>DS70</td>
</tr>
<tr>
<td>P</td>
<td>1</td>
<td>auto door bottom</td>
<td>4131CRL</td>
</tr>
<tr>
<td>RW</td>
<td>1</td>
<td>wall stop</td>
<td>402</td>
</tr>
</tbody>
</table>

### HARDWARE SET NUMBER 16

**1 SINGLE INTERIOR DOOR - PRACTICE**  
3'-0" x 7'-0" x 1-3/4" x WD x HMF x NON-RATED

[Doors: 166E, 166H, 166I, 166J, 170A-1]

<table>
<thead>
<tr>
<th>Item</th>
<th>Qty</th>
<th>Description</th>
<th>Model/Size</th>
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<tr>
<td>SH</td>
<td>3</td>
<td>butt hinges</td>
<td>FBB179 x 4-1/2 x 4-1/2</td>
</tr>
<tr>
<td>SL</td>
<td>1</td>
<td>cyl classroom lock</td>
<td>ND94PD x RHO</td>
</tr>
<tr>
<td>RW</td>
<td>1</td>
<td>kickplate</td>
<td>K1050 x 8&quot; high</td>
</tr>
<tr>
<td>R</td>
<td>1</td>
<td>sound seals</td>
<td>DS70</td>
</tr>
<tr>
<td>P</td>
<td>1</td>
<td>auto door bottom</td>
<td>4131CRL</td>
</tr>
<tr>
<td>RW</td>
<td>1</td>
<td>floor stop</td>
<td>441</td>
</tr>
</tbody>
</table>

### HARDWARE SET NUMBER 17

**1 SINGLE INTERIOR DOOR - OFFICE**  
3'-0" x 7'-0" x 1-3/4" x WD x HMF x NON-RATED

[Doors: 170B, 171B]

<table>
<thead>
<tr>
<th>Item</th>
<th>Qty</th>
<th>Description</th>
<th>Model/Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>SH</td>
<td>3</td>
<td>butt hinges</td>
<td>FBB179 x 4-1/2 x 4-1/2</td>
</tr>
<tr>
<td>SL</td>
<td>1</td>
<td>cyl entrance lock</td>
<td>ND91PD x RHO</td>
</tr>
<tr>
<td>RW</td>
<td>1</td>
<td>kickplate</td>
<td>K1050 x 8&quot; high</td>
</tr>
<tr>
<td>R</td>
<td>1</td>
<td>sound seals</td>
<td>DS70</td>
</tr>
<tr>
<td>P</td>
<td>1</td>
<td>auto door bottom</td>
<td>4131CRL</td>
</tr>
<tr>
<td>RW</td>
<td>1</td>
<td>floor stop</td>
<td>441</td>
</tr>
</tbody>
</table>

**END OF SECTION**
SECTION 08 80 00

GLAZING

1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Glass and glazing for metal frames and wood doors.
   2. Glass and glazing materials and installation requirements are included in this section for other sections referencing this section.

B. Related Requirements:
   2. Section 08 14 16 - Flush Wood Doors: Glazed doors.
   3. Section 10 28 00 - Toilet, Bath, and Laundry Accessories: Metal framed mirrors.

1.2 REFERENCE STANDARDS

A. American National Standards Institute:
   1. ANSI Z97.1 - Safety Glazing Materials Used in Buildings Safety

B. ASTM International:

C. Consumer Product Safety Commission:
D. Glass Association of North America:

E. National Fire Protection Association:
   3. NFPA 257 - Standard on Fire Test for Window and Glass Block Assemblies.

F. Underwriters Laboratories Inc.:
   1. UL 10C - Positive Pressure Fire Tests on Door Assemblies.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data:
   1. Glass: Provide structural and physical characteristics, size limitations, and special handling or installation requirements.
   2. Glazing Sealant and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors where exposed.

C. Samples:
   1. Glass: Submit one sample 12 x 12 inch in size, illustrating each glass unit coloration and design.
   2. Glazing Materials: Submit 6 inch long bead of glazing sealant color.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout submittals.

B. Warranty: Submit manufacturer’s warranty and ensure forms have been completed in Owner’s name and registered with manufacturer.
1.5 QUALITY ASSURANCE

A. Perform Work in accordance with GANA Glazing Manual for glazing installation methods.

B. Fire Rated Window Glazing: Tested in accordance with NFPA 257 and complying with NFPA 80.
   1. NFPA 257; adjusted so two-thirds of test specimen is above neutral pressure plane at 10 minutes into test.

C. Fire Rated Door Glazing: Tested in accordance with one of the following and complying with NFPA 80.
   1. NFPA 252; with neutral pressure level at 40 inches maximum above sill at 5 minutes into test.
   2. UL 10C.

D. Apply label from agency approved by authority having jurisdiction to identify each fire rated glass lite.

1.6 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this Section.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Do not install glazing when ambient temperature is less than 50 degrees F.

C. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.8 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish ten year warranty to include coverage for sealed glass units from seal failure, interpane dusting or misting, and replacement of same.

C. Furnish five year warranty to include coverage for fire resistive glass from delamination and replacement of same.
2. PART 2 PRODUCTS

2.1 GLAZING

A. Manufacturers - Glass:
   1. Reference Manufacturer: Vitro Architectural Glass -
      Products: Standard products unless otherwise noted.
   2. Other Acceptable Manufacturer:
      a. Zeledyne.
      b. AGC Flat Glass North America, Inc.
      c. Cardinal Glass Industries.
      d. Guardian Industries.
      e. Pilkington Group Limited.
   3. Substitutions: Section 01 60 00 - Product Requirements.

B. Manufacturers - Fire Resistive Glazing:
   1. Reference Manufacturer: Technical Glass Products -
      Product: As indicated.
   2. Other Acceptable Manufacturers:
      a. AGC Interedge Technologies.
      b. Safti.
      c. Vetrotech Saint-Gobain.
   3. Substitutions: Section 01 60 00 - Product Requirements.

2.2 COMPONENTS

A. Safety Glass: Conform to ANSI Z97.1, minimum thickness 1/4 inch
   unless otherwise indicated.
   1. Clear Tempered Glass (Type TCPG): ASTM C1048, Kind
      FT Fully tempered, Condition A, uncoated, Type 1
      transparent flat, Class 1 clear, Quality q3 glazing select; with
      horizontal tempering.

B. Fire Resistive Glass: Glazing materials to be types approved for
   use with specified materials in fire rated applications as indicated
   on Drawings.
   1. Fire Resistive Glass (Type FRG): CPSC 16 CFR, Category I
      and II; two or more layers of laminated safety glass
      separated by clear, colorless intumescent interlayers.
      a. Type: FRG-20.
      1) Product: FireLite Plus; fire-rated with hose
         stream test, impact safety-rated.
      2) Thickness: 5/16 inch.
      3) Fire Rating: 20 minute.
b. Type: FRG-45.
   1) Product: Pilkington Pyrostop 45-200; fire-rated with hose stream test, impact safety-rated, block heat transfer.
   2) Thickness: 3/4 inch.
   3) Fire Rating: 45 minute.

C. Insulated Glass Units: Minimum total unit thickness of 1 inch unless otherwise indicated.
   1. Insulated Glass Units - Clear Tempered Glass (Type INS-TCPG): ASTM E2190; double pane insulated unit; with silicone sealant edge seal; inter pane space with dry hermetic air filled; inner pane Glass Type TCPG, outer pane Glass Type TCPG.

2.3 GLAZING SEALANTS

A. Manufacturers - Glazing Sealants:
   1. Dow Corning.
   2. Pecora Corp.
   3. Tremco Inc.
   4. Substitutions: Section 01 60 00 - Product Requirements.

B. Elastomeric Glazing Sealants: Material compatible with adjacent materials including glass, laminated glass core, insulating glass seals, and glazing channels.
   1. Acrylic Glazing Sealant: ASTM C920, Type S, Grade NS, Class and Use suitable for glazing application indicated; single component, solvent curing, non-bleeding; cured Shore A hardness of 15 to 25.
      a. Color: As selected.

2.4 GLAZING ACCESSORIES

A. Manufacturers - Glazing Accessories:
   1. Dow Corning.
   2. Pecora Corp.
   3. Tremco Inc.
   4. Substitutions: Section 01 60 00 - Product Requirements.
B. Setting Blocks: Elastomeric material recommended by glass manufacturer, 80 to 90 Shore A durometer hardness, length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.

C. Spacer Shims: Elastomeric material recommended by glass manufacturer, 50 to 60 Shore A durometer hardness, minimum 3 inch long x one half the height of the glazing stop x thickness to suit application.

D. Glazing Clips: Manufacturer's standard type.

E. Fire-Resistant Glazing Materials: Materials used to obtain required fire-resistant rating.

3. PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify openings for glazing are correctly sized and within acceptable tolerance.

C. Verify surfaces of glazing channels or recesses are clean, free of obstructions impeding moisture movement, weeps are clear, and ready to receive glazing.

3.2 PREPARATION

A. Clean contact surfaces with solvent and wipe dry.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant.
3.3 INSTALLATION

A. Perform installation in accordance with GANA Glazing Manual.
   2. Fire Rated Openings: Comply with NFPA 80.

B. Interior Wet Method (Clips and Sealant) Installation:
   1. Install glazing resting on setting blocks. Install applied stop and center pane by use of spacer shims at 24 inch centers, kept 1/4 inch below sight line.
   2. Locate and secure glazing pane using spring wire clips or glazers' clips.
   3. Fill gaps between glazing and stops with elastomeric glazing sealant until flush with sight line. Tool surface to straight line.

3.4 MANUFACTURER'S FIELD SERVICES

A. Section 01 40 00 - Quality Requirements: Manufacturer's field services.

B. Glass product manufacturers to provide field surveillance of installation.

C. Monitor and report installation procedures and unacceptable conditions.

3.5 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Remove glazing materials from finish surfaces.

C. Remove labels after Work is complete.

D. Clean glass and adjacent surfaces.
3.6 PROTECTION OF INSTALLED WORK

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.

B. After installation, mark pane with an 'X' by using removable plastic tape or paste.

3.7 SCHEDULE

A. Glazing:
   1. Interior Locations:
      b. Metal Frames - Fire Rated: Fire rated glazing system.
      d. Wood Doors - Fire Rated: Fire rated glazing system.

END OF SECTION
1. **PART 1  GENERAL**

1.1 **SUMMARY**

A. Section Includes:
   1. Metal stud wall framing.
   2. Metal channel ceiling framing.
   4. Acoustic insulation.

B. Related Requirements:
   1. Section 06 10 53 - Miscellaneous Rough Carpentry: Wood
      blocking for support of gypsum board.
   2. Section 08 12 13.13 - Standard Hollow Metal Frames: Spot
      mudding of frame anchors.
   3. Section 08 31 13 - Access Doors and Frames: Metal access
      panels.

1.2 **REFERENCE STANDARDS**

A. ASTM International:
   1. ASTM C475 - Standard Specification for Joint Compound
      and Joint Tape for Finishing Gypsum Board.
   2. ASTM C636 - Standard Practice for Installation of Metal
      Ceiling Suspension Systems for Acoustical Tile and Lay-In
      Panels.
   3. ASTM C645 - Standard Specification for Nonstructural Steel
      Framing Members.
   4. ASTM C754 - Standard Specification for Installation of Steel
      Framing Members to Receive Screw-Attached Gypsum Panel
      Products.
   5. ASTM C840 - Standard Specification for Application and
      Finishing of Gypsum Board.
   6. ASTM C1002 - Standard Specification for Steel Drill Screws
      for the Application of Gypsum Panel Products or Metal
      Plaster Bases.
   7. ASTM C1047 - Standard Specification for Accessories for
      Gypsum Wallboard and Gypsum Veneer Base.

B. Gypsum Association:
   1. GA-214 - Recommended Levels of Gypsum Board Finish.

C. International Code Council:
   1. ICC ES AC86 - Cold-Formed Steel Framing Members - Interior Nonload-Bearing Wall Assemblies.

D. Intertek Testing Services (Warnock Hersey Listed):
   1. WH - Certification Listings.

E. Underwriters Laboratories Inc.:
   1. UL - Fire Resistance Directory.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data on metal framing, gypsum board, joint tape, and acoustic accessories.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ASTM C636, ASTM C840, and GA-214.

B. Fire Rated Wall Construction: Rating as indicated on Drawings.
   1. Tested Rating: Determined in accordance with ASTM E119.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section.

B. Installer: Company specializing in performing Work of this Section.
1.6 **PRE-INSTALLATION MEETING**

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

2. **PART 2 PRODUCTS**

2.1 **GYPSUM BOARD SYSTEMS**

A. Manufacturers - Framing:
   2. Custom Stud Inc.
   3. Marino/Ware.
   4. SCAFCO Steel Stud Mfg. Co.
   5. Substitutions: Section 01 60 00 - Product Requirements.

B. Manufacturers - Gypsum Board:
   1. Georgia-Pacific.
   3. USG Corp.
   4. Substitutions: Section 01 60 00 - Product Requirements.

C. Performance / Design Criteria:
   1. Acoustic Attenuation for Identified Interior Partitions: 55 STC in accordance with ASTM E90.
   2. “EQ” (Equivalent Gauge Thickness) Steel Studs and Runners: Manufacturer’s that can show certified third party testing with gypsum board in accordance with ICC ES AC86 - 2012 need not meet minimum thickness limitation or minimum section properties set forth in ASTM C645. Submission of evaluation report is acceptable to show conformance with this requirement.

2.2 **COMPONENTS**

A. Framing Materials:
   1. Studs and Tracks: ASTM C645; galvanized sheet steel, 20 gage, C shape, size as indicated.
   b. Rigid Channels: Galvanized sheet steel, 1-1/2 inch depth weighing 0.475 lb/ft minimum; 3/4 inch depth weighing 0.30 lb/ft minimum.

3. Fasteners: ASTM C1002; Type S; length to suit application.

4. Anchorage to Substrate: Nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

B. Gypsum Board Materials: ASTM C1396/C1396M; Type X fire resistant where indicated on Drawings.
   1. Standard Gypsum Board: 5/8 inch thick, maximum available length in place; ends square cut, tapered edges.
   2. Gypsum Base: 5/8 inch thick; square edges, ends square cut, maximum available size in place.

2.3 ACCESSORIES

A. Acoustic Insulation: Preformed mineral fiber, friction fit type, unfaced, 3 inch thick.
   1. Manufacturers:
      b. Substitutions: Section 01 60 00 - Product Requirements.

B. Acoustic Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board.
   1. Manufacturer’s:
      b. Substitutions: Section 01 60 00 - Product Requirements.
C. Gypsum Board Accessories: ASTM C1047; metal.
   1. Manufacturers:
      a. Reference Manufacturer: ClarkDietrich Building Systems - Products: As indicated.
      b. Substitutions: Section 01 60 00 - Product Requirements.
   2. Corner Beads: Galvanized steel; 103 Deluxe Corner Bead.
   3. Edge Trim: Galvanized steel; #400 Metal J-Trim.
   4. Control Joint: Zinc; #093 Zinc Control Joint.


E. Gypsum Board Screws: ASTM C1002; length to suit application.
   1. Screws for Steel Framing: Type S.

3. PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

   B. Verify site conditions are ready to receive Work and opening dimensions are as instructed by manufacturer.

3.2 EXISTING WORK

   A. Extend existing gypsum board installations using materials and methods as specified.

   B. Repair and remodel existing gypsum board assemblies which remain or are to be altered.

   C. Remove abandoned screws, nails, expansion anchors, and expansion anchor sleeves previously used to hang or support components off of wall and fill unused exposed-to-view holes in existing gypsum board. Fill with joint compound and sand filler smooth.
3.3 INSTALLATION

A. Metal Stud Installation:
1. Install studs in accordance with ASTM C754.
2. Metal Stud Spacing: 16 inches on center, unless noted otherwise.
3. Refer to Drawings for indication of partitions extending stud framing through ceiling to structure above. Maintain clearance under structural building members to avoid deflection transfer to studs.
4. Door Opening Framing: Install double studs at door frame jambs. Install stud tracks on each side of opening, at frame head height, and between studs and adjacent studs.
5. Layout framing to avoid gypsum board end joint alignment with edges of opening. Install expansion and control joints as indicated, or if not indicated, on maximum 30 foot centers, position to intersect weak spots in gypsum board surface and corners of openings.
6. Blocking: Bolt or screw wood blocking to studs. Install blocking for support of plumbing fixtures, toilet partitions, wall cabinets, equipment furnished by Owner, and similar fixtures.
7. Backing Strip: Screw steel strips to studs. Install backing strips for support of wall mounted door stops, toilet accessories, tackboards, markerboards, and similar fixtures.

B. Wall Furring Installation:
1. Erect wall furring for direct attachment to walls.
2. Erect furring channels vertically; space maximum 16 inches oc. Secure in place on alternate channel flanges at maximum 24 inches on center.

C. Ceiling Framing Installation:
1. Install in accordance with ASTM C754.
2. Coordinate location of hangers with other work.
3. Install ceiling framing independent of walls, columns, and above ceiling work.
4. Reinforce openings in ceiling suspension system which interrupt main carrying channels or furring channels, with lateral channel bracing. Extend bracing minimum 24 inches past each end of openings.
5. Laterally brace entire suspension system as required.
D. Acoustic Accessories Installation:
1. Place acoustic insulation in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions, and tight to items passing through partitions.
2. Install acoustic sealant at gypsum board perimeter at:
   a. Metal Framing: One bead.
   b. Base Layer.
   c. Face Layer.
   d. Seal penetrations of partitions by conduit, pipe, ductwork, rough-in boxes, and beneath control joints at non-rated partitions.

E. Gypsum Board Installation:
1. Install gypsum board in accordance with ASTM C840.
2. Erect single layer standard gypsum board in most economical direction, with ends and edges occurring over firm bearing.
3. Erect single layer fire rated gypsum board vertically, with edges and ends occurring over firm bearing.
4. Use screws when fastening gypsum board to metal framing.
5. Use screws when fastening gypsum board to wood furring.
6. Double Layer Applications: Use gypsum base for first layer, placed perpendicular to framing or furring members. Use fire rated gypsum base for fire rated partitions.
7. Double Layer Applications: Secure second layer to first with fasteners.
8. Place second layer perpendicular to first layer. Offset joints of second layer from joints of first layer.
9. Place control joints consistent with lines of building spaces at locations and spacing as indicated below, or as indicated on Drawings.
   a. Interior Ceilings (Without Perimeter Relief): 30 feet maximum in either direction.
   b. Interior Ceilings (With Perimeter Relief): 50 feet maximum in either direction.
   c. Interior Partitions: 30 feet maximum in either direction.
   d. Door Window Frames: Extend from both corners of top of jamb frames to tops of partitions.
10. Place corner beads at external corners, or as indicated on Drawings. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials as indicated on Drawings.
11. Spot mud jamb anchors of all hollow metal door and borrowlite frames with joint compound. Apply mud before inserting gypsum wallboard into door frame. Do not terminate gypsum wallboard against frame return.

12. Coordinate installation of tile backer board specified in Section 09 30 00.

F. Joint Treatment:
1. Finish in accordance with GA-214; Levels as Scheduled.
2. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
3. Feather coats on to adjoining surfaces so that camber is maximum 1/32 inch.

3.4 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation of Finished Gypsum Board Surface from Flat Surface: 1/8 inch in 10 feet in any direction.

3.5 SCHEDULE

A. Gypsum Board Assemblies:
1. Standard Gypsum Board and Standard Gypsum Base:
   a. Interior non-rated partitions, where indicated.
   b. Interior non-rated ceilings and bulkheads, where indicated.
2. Fire Rated Gypsum Board and Fire Rated Gypsum Base:
   a. Interior fire rated partitions, where indicated.
3. Acoustic Attenuation - Acoustic Insulation and Sealant:
   a. Interior partitions, where indicated.
4. Gypsum Board Finish Levels: Finishes in accordance with GA-214 Level:
   a. Level 1: Above finished ceilings concealed from view.
   b. Level 4: Walls exposed to view.

END OF SECTION
SECTION 09 23 00

GYPSUM PLASTERING

1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Gypsum plaster.
   2. Metal furring and lath.

1.2 REFERENCE STANDARDS

A. ASTM International:

B. Gypsum Association:
   1. GA 216 - Application and Finishing of Gypsum Board.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data on plaster materials, characteristics, and limitations of products specified.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with GA-216.
1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section.

B. Installer: Company specializing in performing Work of this Section.

1.6 MOCKUP

A. Section 01 40 00 - Quality Requirements: Requirements for mockup.

B. Construct mockup, of representative patched wall area, illustrating surface finish.

C. Locate where directed by Architect/Engineer.

D. Incorporate accepted mockup as part of Work.

1.7 PRE-INSTALLATION MEETING

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing Work of this Section.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Do not apply plaster when substrate or ambient air temperature is less than 50 degrees F nor more than 80 degrees F.

C. Maintain minimum ambient temperature of 50 degrees F during and after installation of plaster.
2. PART 2 PRODUCTS

2.1 GYPSUM PLASTERING

A. Manufacturers:
   1. National Gypsum Co.
   2. United States Gypsum Company.
   3. Substitutions: Section 01 60 00 - Product Requirements.

2.2 COMPONENTS

A. Plaster Base Materials:
   2. Water: Clean, fresh, potable and free of mineral or organic matter capable of affecting plaster.
   3. Bonding Agent: ASTM C631; type recommended for bonding plaster to existing plaster.

B. Finishing Plaster:
   2. Water: Clean, fresh, potable and free of material and organic matter capable of affecting plaster.

C. Metal Lath: ASTM C847; flat diamond mesh or self-furring mesh; weight to suit application, backed with treated paper; galvanized.

2.3 ACCESSORIES

A. Casing Bead: Formed zinc, depth governed by plaster thickness, maximum possible lengths, expanded metal flanges, with square edges; galvanized.
   1. Manufacturers:
      b. Substitutions: Section 01 60 00 - Product Requirements.
B. Corner Bead: Formed zinc, depth governed by plaster thickness, maximum possible lengths, expanded metal flanges with radiused edge; galvanized.
   1. Manufacturers:
      b. Substitutions: Section 01 60 00 - Product Requirements.

C. Corner Mesh: Formed sheet steel, minimum 0.018 inch thick, perforated flanges shaped to permit complete embedding in plaster, minimum 2 inch size; galvanized.

D. Strip Mesh: Expanded metal lath, minimum 0.018 inch thick, 2 inch wide x 24 inch long; galvanized.

E. Anchorage: Nails, staples, or other approved metal supports, of type and size to suit application, to rigidly secure lath and associated metal accessories in place.

2.4 MIXES

A. Mix and proportion plaster in accordance with ASTM C842.

3. PART 3 EXECUTION

3.1 PREPARATION

A. Apply bonding agent to edges of existing plaster.

3.2 EXISTING WORK

A. Extend existing gypsum plaster installations using materials and methods as specified.

B. Repair existing gypsum plaster which remains or is to be remodeled.
3.3 INSTALLATION

A. Apply metal lath taut, with long dimension perpendicular to supports.

B. Lap ends minimum 1 inch. Secure end laps with tie wire where they occur between supports.

C. Lap sides of diamond mesh lath minimum 1-1/2 inches.

D. Attach metal lath to metal supports using tie wire at maximum 6 inches on center.

E. Installation of Accessories:
   1. Continuously reinforce internal angles with corner mesh, return metal lath 3 inches from corner to form angle reinforcement; fasten at perimeter edges only.
   2. Place corner bead at external wall corners; fasten at outer edges of lath only.
   3. Place strip mesh diagonally at corners of lathed openings. Secure rigidly in place.
   4. Place 4 inch wide strips of metal lath centered over junctions of dissimilar backing materials. Secure rigidly in place.

F. Plastering:
   1. Apply gypsum plaster in accordance with ASTM C842.
   2. Apply scratch, brown, and finish coats over metal lath surfaces. Apply scratch and brown coats to nominal thickness to match existing.
   3. Apply finish coat to minimum thickness to match existing.
   4. Work finish coat to match existing adjacent surfaces.
   5. Perform Work in panels to nearest natural break or between accessories.

3.4 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation from Flat Surface: 1/8 inch in 10 feet.
3.5 SCHEDULE

A. Gypsum Plastering:
   1. Infill, and Patch and Repair Areas: Three coat gypsum plaster over metal lath; thickness and finish to match existing.

END OF SECTION
SECTION 09 30 00

TILING

1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Ceramic tile for floor and wall applications.
   2. Tile backer board as tile substrate.

B. Related Requirements:
   1. Section 03 30 00 - Cast-In-Place Concrete.

1.2 REFERENCE STANDARDS

A. American National Standards Institute:
   1. ANSI A108.1 - Installation of Ceramic Tile, A collection.
   2. ANSI A108.5 - Specifications for Ceramic Tile Installed with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.
   4. ANSI A118.4 - Latex-Portland Cement Mortar.
   5. ANSI A118.6 - Ceramic Tile Grouts.
   6. ANSI A137.1 - Ceramic Tile.

B. ASTM International:

C. Tile Council of America:

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control joints, accessories, and setting details.
C. Product Data: Submit instructions for using mortars and grouts.

D. Samples: Submit two sets of samples for Architect/Engineer's selection of tile and grout colors.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout submittals.

B. Operation and Maintenance Data: Submit recommended cleaning methods, cleaning materials, and stain removal methods.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with TCA Handbook and ANSI A108 Series/A118 Series.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section.

B. Installer: Company specializing in performing Work of this Section.

1.7 PRE-INSTALLATION MEETING

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing Work of this Section.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Protect mortar and grout from freezing or overheating.
1.9 ENVIRONMENTAL REQUIREMENTS
A. Section 01 60 00 - Product Requirements.
B. Do not install mortar or grout in unventilated environment.
C. Maintain ambient and substrate temperature of 50 degrees F during installation of mortar and grout materials.

1.10 EXTRA MATERIALS
A. Section 01 70 00 - Execution and Closeout Requirements.
B. Supply two percent of each size, color, and surface finish of tile specified.

2. PART 2 PRODUCTS

2.1 TILING
A. Manufacturers - Ceramic Tile:
   1. Ceramic Wall Tile (CT-A): Daltile - Product: VOLUME 1.0
   2. Ceramic Wall/Floor Tile (CT-B): Dal-Tile - Product: VOLUME 1.0
   3. Substitutions: Section 01 60 00 - Product Requirements.
B. Manufacturers - Mortar and Grout:
   1. Bostik Findley.
   2. H.B. Fuller Construction Products, Inc.
   3. Laticrete.
   5. Substitutions: Section 01 60 00 - Product Requirements.
C. Manufacturers: Tile Backer Board:
   3. Substitutions: Section 01 60 00 - Product Requirements.
D. Manufacturers - Metal Trim Edging and Profiles:
   1. Schluter Systems - Products:
      a. Floor Tile Edging: SCHIENE.
      b. Wall Tile Edging: JOLLY.
      c. Coved-Shaped Profile: DILEX-HKU.
   2. Substitutions: Section 01 60 00 - Product Requirements.

2.2 COMPONENTS

A. Ceramic Wall Tile (CT-A): ANSI A137.1, conforming to the following:
   1. Moisture Absorption: 0 to 0.5 percent.
   2. Size: 12 x 24 x 5/16 inch.
   4. Edge: Cushioned.
   5. Surface Finish: Glazed; dynamic coefficient of friction (DCOF) greater than or equal to 0.42; measured in accordance with ANSI A137.1, DCOF Acu Test.
   6. Colors: As Scheduled.

B. Ceramic Floor/Wall Tile (CT-B): ANSI A137.1, conforming to the following:
   1. Moisture Absorption: 0 to 0.5.
   2. Size: 12 x 12 x 5/16 inch.
   3. Shape: Square.
   4. Edge: Cushioned.
   5. Surface Finish: Glazed; dynamic coefficient of friction (DCOF) greater than or equal to 0.42; measured in accordance with ANSI A137.1, DCOF Acu Test.
   6. Colors: As Scheduled.

2.3 ACCESSORIES

A. Mortar Materials:

B. Grout Materials:
   1. Grout: Latex-Portland cement type as specified in ANSI A118.6
      a. Color: As Scheduled.
C. Tile Backer Board: ASTM C1178; moisture resistant and fire resistant type, 5/8 inch thick, maximum available length in place; ends square cut, square edges, glass fiber mat facers both sides, acrylic coated front facer. Provide complete with 2 inch wide, 10/10 glass mesh tape for joints and corners.

D. Sealant: As specified in Section 07 92 00.

E. Metal Trim Edging and Profiles:
   1. Floor Tile Edging: Sloped transition surface, rounded edge, perforated anchoring leg; Type 304 brushed stainless steel; sized to accommodate tile thickness and setting material.
   2. Wall Tile Edging: Sloped transition surface, rounded edge, perforated anchoring leg; brush chrome anodized aluminum; sized to accommodate tile thickness and setting material; complete with connectors.
   3. Cove-Shaped Profile: 3/8 inch radius cove, square transitions, perforated anchoring leg; Type 304 brushed stainless steel; sized to accommodate tile thickness and setting material; complete with inside and outside corners and connectors; for use at floor/wall tile transitions.

3. PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify surfaces are ready to receive Work.

3.2 PREPARATION

A. Protect surrounding work from damage.

B. Vacuum clean surfaces and damp clean.

C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
D. Tile Backer Board:
   1. Install tile backer board in accordance with manufacturer’s instructions.
   2. Tape joints and corners; cover with skim coat of latex-Portland cement mortar to feather edge.

3.3 INSTALLATION

A. Install tile, mortar, and grout in accordance with applicable requirements of ANSI A108.1 through A108.10, and TCA Handbook recommendations.

B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

C. Place metal floor trim edging at exposed tile edges or locations indicated.

D. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly.

E. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout.

F. Form interior wall/wall angles square, exterior wall/wall angles trimmed with metal wall trim edging, and internal wall/floor angles trimmed with metal cove-shaped profile.

G. Sound tile after setting. Replace hollow sounding units.

H. Install floor control joints at 12’ in each direction for rooms exceeding 12’ in width. Keep control joints free of mortar or grout. Apply sealant to joints.

I. Allow tile to set for a minimum 48 hours prior to grouting.

J. Grout tile joints.

K. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.
L. Installation - Floors:

M. Installation - Wall Tile:
   1. Over tile backer units install in accordance with TCA Handbook Method W245, latex-portland cement bond coat, with latex-portland cement grout.

3.4 CLEANING
   A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
   B. Clean tile and grout surfaces.

3.5 PROTECTION OF INSTALLED WORK
   A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.
   B. Do not permit traffic over finished floor surfaces for 4 days after installation.

3.6 SCHEDULE
   A. Tiling:
      1. Ceramic Tile:
         a. Ceramic Wall Tile (CT-A): 1 color for Project, as selected.
         b. Ceramic Floor/Wall Tile (CT-B): 2 colors for Project, as selected.
      2. Grout:
         a. Ceramic Wall Tile Grout: 1 color for Project, as selected.
         b. Ceramic Floor/Wall Tile Grout: 1 color for Project, as selected.

END OF SECTION
SECTION 09 51 13

ACOUSTICAL PANEL CEILINGS

1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Acoustic panels.
   2. Suspended metal grid ceiling system and perimeter trim.

B. Related Requirements:
   1. Division 21 - Fire Suppression: Sprinkler heads in ceiling system.
   3. Division 26 - Electrical: Light fixtures in ceiling system.
   4. Division 27 - Communications: Speakers in ceiling system.

1.2 REFERENCE STANDARDS

A. ASTM International:
   4. ASTM E1264 - Standard Classification for Acoustical Ceiling Products.

B. Ceilings and Interior Systems Construction Association:
   1. CISCA - Acoustical Ceilings: Use and Practice.
1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings:
   1. Indicate grid layout and related dimensioning, junctions with other work or ceiling finishes, and interrelation of mechanical and electrical items related to system. Indicate method of suspension where interference exists.

C. Product Data: Submit data on metal grid system components and acoustic units.

D. Samples:
   1. Submit two samples, 4 x 6 inches in size, illustrating material and finish of acoustic units.
   2. Submit two samples each, 6 inches long, of suspension system main runner, cross runner, and perimeter molding.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Warranty: Submit manufacturer’s warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

A. Conform to CISCA requirements.

B. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section.

B. Installer: Company specializing in performing Work of this Section.
1.7 PRE-INSTALLATION MEETING

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing Work of this Section.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Section 01 50 00 - Temporary Facilities and Controls.

B. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustic unit installation.

1.9 SEQUENCING

A. Section 01 11 00 - Summary of Work: Requirements for sequencing.

B. Sequence Work to ensure acoustic ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

C. Install acoustic units after interior wet work is dry.

1.10 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for extra materials.

B. Extra Materials:
   1. Furnish one percent of total acoustic unit area of extra units to Owner for each size and type specified.

1.11 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements.

B. Warranty: Provide ten year manufacturer warranty for ceiling panels. Include coverage against visible sag.
2. PART 2 PRODUCTS

2.1 ACOUSTICAL PANEL CEILINGS

A. Manufacturers - Acoustic Units:
   1. Reference Manufacturer: USG Interiors, Inc. - Product: RADAR ClimaPlus No. 2220 (Type A), Premier Nubby ClimaPlus No. 7002G.
   2. Other Acceptable Manufacturers:
      a. Armstrong Commercial Ceilings & Walls.
      b. CertainTeed Corp.
   3. Substitutions: Section 01 60 00 - Product Requirements.

B. Manufacturers - Grid:
   1. Reference Manufacturer: USG Interiors, Inc. - Product: DX (Type 1).
   2. Other Acceptable Manufacturers:
      a. Armstrong Commercial Ceilings & Walls.
      b. CertainTeed Corp.
      c. Chicago Metallic Corp.
   3. Substitutions: Section 01 60 00 - Product Requirements.

C. Performance / Design Criteria:
   1. Suspension System: Rigidly secure acoustic ceiling system including integral mechanical and electrical components with maximum deflection of 1/240 of span.

2.2 COMPONENTS

A. Acoustic Panels (Type A): ASTM E1264, Type III, Form 2, Pattern CD, non-fire rated type; conforming to the following:
   1. Size: 24 x 24 inches.
   2. Thickness: 5/8 inches.
   3. Composition: Mineral fiber.
   4. Light Reflectance: LR-0.84.
   5. NRC: 0.55.
   6. CAC: 33, minimum.
   7. Edge: Tegular.
   9. Surface Finish: Medium textured, non-directional.
B. Acoustic Panels (Type C): ASTM E1264, Type XII, Form 2, Pattern E, non-fire rated type; conforming to the following:
   1. Size: 24 x 24 inches.
   2. Thickness: 1 inch.
   4. Light Reflectance: LR-0.87.
   5. NRC: 0.90.
   6. CAC: --.
   7. Edge: Square.
   9. Surface Finish: Woven fiberglass cloth facing

C. Grid:
   1. Non-Fire Rated Grid (Type 1): ASTM C635, heavy duty; exposed T with steel cap; components die cut and interlocking.
      a. Grid Materials: Commercial quality cold rolled steel with galvanized coating.
      b. Exposed Grid Surface Width: 15/16 inch.
      c. Perimeter Molding Width: Match grid width.
      e. Accessories: Clips, splices, and perimeter moldings, required for suspended grid system.
      f. Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.

D. Fascia Trim:
   1. Fascia Trim: Exposed fascia trim; components die cut and interlocking with grid.
   2. Fascia Trim Materials: Commercial quality cold rolled steel with galvanized coating or extruded aluminum.
      a. Exposed Fascia Trim Height: 2-1/2 inches.
   3. Accessories: Clips, splices, and hold down clips required for suspended grid system.
2.3 ACCESSORIES

A. Acoustic Sealant For Perimeter Moldings.
   1. Manufacturers:
      a. Reference Manufacturer: United States Gypsum -
         Product: SHEETROCK Acoustical Sealant.
      b. Substitutions: Section 01 60 00 - Product
         Requirements.

B. Touch-Up Paint: Type and color to match grid units.

3. PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements:
   Requirements for installation examination.

B. Verify layout of hangers will not interfere with other work.

3.2 EXISTING WORK

A. Extend existing acoustical ceiling installations using materials and
   methods matching existing.

B. Clean and repair existing acoustical ceilings which remain or are to
   be reinstalled.

3.3 INSTALLATION

A. Lay-In Grid Suspension System:
   1. Install suspension system in accordance with ASTM C635,
      ASTM C636 and as supplemented in this section.
   2. Install system capable of supporting imposed loads with
      maximum deflection of 1/240.
   3. Locate system on room axis according to reflected ceiling
      plan.
   4. Install after major above ceiling work is complete.
      Coordinate location of hangers with other Work.
   5. Hang suspension system independent of walls, columns,
      ducts, pipes and conduit. Where carrying members are
      spliced, avoid visible displacement of face plane of adjacent
      members.
6. Where ducts or other equipment prevent regular spacing of hangers, reinforce nearest affected hangers to span extra distance.

7. Do not support components on main runners or cross runners when weight causes total dead load to exceed deflection capability. Support fixture loads by supplementary hangers located within 6 inches of each corner; or support components independently.

8. Do not eccentrically load system, or produce rotation of runners.

9. Perimeter Molding:
   a. Install edge molding at intersection of ceiling and vertical surfaces into bed of acoustic sealant.
   b. Use longest practical lengths.
   c. Miter corners.
   d. Install at junctions with other interruptions.
   e. Where bullnose concrete block corners occur, install preformed closures to match perimeter moldings.

B. Acoustic Units:
   1. Fit acoustic units in place, free from damaged edges or other defects detrimental to appearance and function.
   2. Lay directional patterned units one way with pattern parallel to shortest room axis. Fit border trim neatly against abutting surfaces.
   3. Install units after above ceiling work is complete.
   4. Install acoustic units level, in uniform plane, and free from twist, warp, and dents.
   5. Cutting Acoustic Units:
      a. Cut to fit irregular grid and perimeter edge trim.
      b. Cut square edges to field cut square edge units; double cut and field paint exposed edges of tegular units.
   6. Where bullnose concrete block corners or round obstructions occur, install preformed closures to match perimeter molding.

3.4 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
C. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.5 SCHEDULE

A. Acoustical Panel Ceilings:
   1. General Areas (APC-A): Type A acoustic panels and Type 1 suspension grid.
   2. Music Areas (APC-C): Type C acoustic panels and Type 1 suspension grid.

END OF SECTION
SECTION 09 65 00
RESILIENT FLOORING

1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   2. Resilient tile flooring.
   3. Resilient base.

1.2 REFERENCE STANDARDS

A. ASTM International:

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data describing physical and performance characteristics; including sizes, patterns and colors available; adhesive and primer materials; and installation instructions.

C. Samples: Submit two sets of samples for Architect/Engineer's selection of colors.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout submittals.

B. Operation and Maintenance Data: Submit maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
1.5 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing Products specified in this Section.
B. Installer: Company specializing in performing Work of this Section.

1.6 DELIVERY, STORAGE, AND HANDLING
A. Section 01 60 00 - Product Requirements: Product storage and handling.
B. Protect roll materials from damage by storing on end.

1.7 ENVIRONMENTAL REQUIREMENTS
A. Section 01 60 00 - Product Requirements.
B. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
C. Store materials for not less than 48 hours prior to installation in area of installation at temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

1.8 EXTRA MATERIALS
A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
B. Floor Covering: Furnish one percent of total floor covering area of extra tile to Owner for each tile size, color, and pattern specified.
C. Base: Furnish one percent of total base length of extra base to Owner for each base size, color, and pattern specified.

1.9 WARRANTY
A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
B. Luxury Vinyl Tile (LVT) Flooring: Provide manufacturer’s Standard 15 year warranty.
2. PART 2 PRODUCTS

2.1 TILE FLOORING

A. Manufacturers - Luxury Vinyl Tile (LVT):
   2. Substitutions: Section 01 60 00 - Product Requirements.

B. Luxury Vinyl Tile (LVT): ASTM F1700, Class 3, Type B:
   1. Size: 9.845 x 39.38 inches (25cm x 1m).
   2. Overall Thickness: 0.177 inch (4.5mm).
   3. Finish: Ceramor.
   4. Colors: As Scheduled.

2.2 RESILIENT BASE

A. Manufacturers:
   1. Armstrong Commercial Flooring.
   2. Burke Flooring Products.
   3. Flexco.
   5. Mercer.
   6. Roppe Corporation.
   8. VPI Corporation.
   9. Substitutions: Section 01 60 00 - Product Requirements.

B. Base: ASTM F1861, vinyl or rubber; top set coved:
   1. Height: 4 inch typical.
   2. Thickness: 0.125 inch thick.
   3. Finish: Matte.
   4. Length: Roll.
   5. Accessories: Premolded external and internal corners.

2.3 ACCESSORIES

A. Subfloor Filler: Cementitious; type recommended by adhesive material manufacturer.

B. Primers: Waterproof; type recommended by flooring manufacturer.

C. Adhesives: Manufacturer’s brand name adhesive; solvent-free, non-flammable, moisture resistant transitional pressure sensitive adhesive type.
D. Adaptors: Vinyl tile/carpet type; 2-1/2 inches wide, bevel down from carpet tile to vinyl tile, full width of openings.

E. Reducers: Vinyl tile/concrete floor type; 1-5/8 inches wide, bevel down from vinyl tile to concrete flooring; full width of openings.

3. PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verify of existing conditions before starting work.

B. Verify existing concrete substrate surfaces are smooth and flat, are within manufacturers tolerances.

C. Verify existing concrete substrate surfaces are ready for resilient flooring installation by testing for moisture emission rate using in situ probes to measure relative humidity in accordance with ASTM F2170. Tests shall be conducted at Architect/Engineer pre-approved locations, at test rate of 1 test for each 1000 sq ft of floor area. Obtain written instructions from flooring manufacturer if test results are not within stated limits.
   1. Relative Humidity:
      a. Tile Flooring: Not greater than 90 percent.

D. Verify existing concrete substrate surface alkalinity by testing in accordance with resilient flooring manufacturers recommendations. Tests shall be conducted at Architect/Engineer pre-approved locations at rate of 1 test for each 1000 sq ft of floor area. Obtain instructions from resilient flooring manufacturer if test results are not within specified limits.
   1. Allowable Alkalinity Range: 5 to 9 on pH scale.

E. Verify floor and lower wall surfaces are free of substances capable of impairing adhesion of new adhesive and finish materials.
3.2 PREPARATION

A. Remove sub-floor ridges, bumps, and relative humidity test probe sleeves. Fill minor low spots, cracks, joints, holes, test probe sleeve holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.

1. At areas where new resilient flooring is indicated to be installed over existing concrete sub-floors, remove residual adhesive remaining after existing carpet or resilient flooring has been removed. Fill sub-floor surfaces as indicated above; maximum surface variation shall be 1/8 inch in 10 feet; assume 10 percent of existing sub-floor surfaces will require grinding and filler.

B. Prohibit traffic until filler is cured.

C. Clean substrate.

D. Apply primer as required to prevent "bleed-thru" or interference with adhesion by substances that cannot be removed.

3.3 EXISTING WORK

A. Extend existing resilient flooring installations using materials and methods compatible with existing installations.

3.4 INSTALLATION

A. Installation - Tile Flooring:

1. Mix tile from container to ensure shade variations are consistent when tile is placed.

2. Lay flooring with joints and seams parallel to building lines to produce symmetrical tile pattern.

3. Install tile to basket weave pattern. Allow minimum 1/2 full size tile width at room or area perimeter.

4. Scribe flooring to walls, cabinets, and other appurtenances to produce tight joints.

5. Where floor finishes are different on opposite sides of door, terminate flooring under centerline of door.

6. Install reducers and adaptors at unprotected or exposed edges, where flooring terminates, and where indicated. Secure resilient reducers and adaptors by adhesive.
B. Installation - Resilient Base:
   1. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
   2. At internal and external corners, install premolded units.
   3. Install base on solid backing. Bond tightly to wall and floor surfaces.
   4. Scribe and fit to door frames and other interruptions.

3.5 CLEANING
A. Section 01 70 00 - Execution and Closeout Requirements: Final work.
B. Remove excess adhesive from floor, base, and wall surfaces without damage.

3.6 PROTECTION OF INSTALLED WORK
A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed work.
B. Prohibit traffic on resilient flooring for 48 hours after installation, and 24 hours after burnishing.

3.7 SCHEDULE
A. Resilient Flooring:
   1. Luxury Vinyl Tile (LVT) Flooring: 1 color for Project, as selected.
   2. Base: 2 colors for Project, as selected.
   3. Adaptors: 1 color for Project, as selected.
   4. Reducers: 1 color for Project, as selected.

END OF SECTION
SECTION 09 68 13
TILE CARPETING

1. PART 1  GENERAL

1.1 SUMMARY

A. Section Includes:
   2. Carpet tile, fully adhered.
   3. Accessories.

B. Related Requirements:
   1. Section 09 30 00 - Tiling: Termination edging of adjacent floor finish.
   2. Section 09 65 00 - Resilient Flooring: Base finish.

1.2 REFERENCE STANDARDS

A. American Association of Textile Chemists and Colorists:
   1. AATCC 134 - Electrostatic Propensity of Carpet.

B. ASTM International:

C. Carpet and Rug Institute:

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate layout of joints, direction of carpet pile, and location of adaptors.
C. Product Data: Submit data on specified products, describing physical characteristics; adhesive and primer materials, and method of installation.

D. Samples: Submit two full size carpet tiles illustrating color and pattern for carpet color specified

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Operation and Maintenance Data: Submit maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

C. Warranty: Submit manufacturer’s warranty and ensure forms have been completed in Owner’s name and registered with manufacturer.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section.

B. Installer: Company specializing in performing Work of this Section.

1.6 PRE-INSTALLATION MEETING

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting requirements.

B. Convene minimum one week prior to commencing Work of this Section.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Section 01 50 00 - Temporary Facilities and Controls.

B. Store materials in area of installation for 48 hours prior to installation.
1.8 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Provide manufacturer’s warranty for the following time periods:

1.9 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Extra Materials:
   1. Supply 24 carpet (CPT-T-A) tiles of each carpet color and pattern selected.

2. PART 2 PRODUCTS

2.1 TILE CARPETING

A. Manufacturers - Carpet Tile (CPT-T-A):
   1. Reference Manufacturer: Interface - Product: Primary Stitch Colorline.
   2. Substitutions: Not permitted.

2.2 COMPONENTS

A. Carpet Tile (CPT-T-A): Conforming to the following criteria:
   1. Tile Size: Modular; 24 x 24 inch.
   2. Backing System: GlasBac Tile.
   4. Yarn System: Post-consumer content Type 6,6 nylon.
   5. Color System: 100% solution dyed.
   9. NBS Smoke: ASTM E662; less than 450.
   10. Electrostatic Propensity: AATCC 134; less than 3 Kv; built-in permanent conductive fiber.
11. Pile Thickness: 0.069 inch.
13. Total Recycled Content: 50%.

2.3 ACCESSORIES

A. Sub-Floor Filler: Cementitious type recommended by flooring material manufacturer.

B. Adaptors:
   1. Carpet/concrete floor type.
   2. Bevel down from 1/4 inch carpet to concrete flooring; full width of openings.
   3. Width: 2-1/2 inches.
   4. Length: Longest available.
   5. Color: As Scheduled.
   6. CTA-XX-J Carpet Adaptor manufactured by Johnsonite.
      a. Substitutions: Section 01 60 00 - Product Requirements.

C. Adhesive: Manufacturer's brand name adhesive; high-solids, ultra premium acrylic pressure sensitive commercial carpet adhesive.

3. PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify floor surfaces are smooth and flat within tolerances specified in Section 03 35 00 and are ready to receive work.

C. Verify concrete substrate surfaces are ready for carpet tile flooring installation by testing for moisture emission rate using in-situ probes to measure relative humidity in accordance with ASTM F2170. Tests shall be conducted at Architect/Engineer pre-approved locations, at test rate of 1 test for each 1000 sq ft of floor area. Obtain written instructions from flooring manufacturer if test results are not within stated limits.
   1. Relative Humidity: Not greater than 85 percent.
D. Verify concrete substrate surface alkalinity by testing in accordance with carpet tile flooring manufacturers recommendations. Test shall be conducted at Architect/Engineer pre-approved locations at rate of 1 test for each 1000 sq ft of floor area. Obtain instructions from carpet tile flooring manufacturer if test results are not within specified limits.
   1. Allowable Alkalinity Range: 5 to 9 on pH scale.

E. Verify floor surfaces are free of substances capable of impairing adhesion of new adhesive and finish materials.

3.2 PREPARATION

A. Remove sub-floor ridges, bumps, and relative humidity test probe sleeves. Fill minor or local low spots, cracks, joints, holes, test probe sleeve holes, and other defects with sub-floor filler.
   1. At areas where new carpet tile is indicated to be installed over existing concrete sub-floors, remove residual adhesive remaining after existing carpet or resilient flooring has been removed. Fill sub-floor surfaces as indicated above; maximum surface variation shall be 1/8 inch in 10 feet; assume 10 percent of existing sub-floor surfaces will require grinding and filler.

B. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.

C. Clean substrate.

3.3 EXISTING WORK

A. Extend existing tile carpet flooring installations using materials and methods compatible with existing installations.

3.4 INSTALLATION

A. Install carpet tile in accordance with CRI 104.

B. Do not mix carpet from different cartons unless from same dye lot.

C. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
D. Install carpet tile in Architect/Engineer directed pattern, set parallel to building lines.

E. Locate change of color or pattern between rooms under door centerline.

F. Fully adhere carpet tile to substrate.

G. Trim carpet tile neatly at walls and around interruptions.

H. Complete installation of adaptors, concealing exposed edges.

3.5 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Remove excess adhesive from floor, base, and wall surfaces without damage.

C. Clean and vacuum carpet surfaces.

3.6 SCHEDULE

A. Tile Carpeting:
   2. Adaptors: 1 color for Project, as selected.

END OF SECTION
1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fabric covered acoustic wall panels.

B. Related Requirements:
   1. Section 09 51 13 - Acoustical Panel Ceilings.

1.2 REFERENCE STANDARDS

A. ASTM International:

1.3 PERFORMANCE REQUIREMENTS

A. Noise Reduction Coefficient (NRC): As indicated below, when tested in accordance with ASTM C423.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings:
   1. Indicate layout and dimensions of acoustical wall panels, core materials, and fabric face.
   2. Indicate interface with adjacent materials.

C. Product Data: Provide data on acoustical panels and accessory materials.
D. Samples: Submit two samples of each component illustrating construction, profile and surface texture and finish.
   1. Core Samples: Minimum 12 x 12 inches in size to illustrate core construction.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout submittals.


1.6 QUALITY ASSURANCE

A. Surface Burning Characteristics:
   1. Acoustical Wall Panels: Comply with the following:
      a. Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section.

B. Installer: Company specializing in performing Work of this Section.

1.8 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing Work of this Section.
1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in manufacturers original packaging. Inspect for damage.

C. Store materials indoors with environmental conditions as specified for installation.

D. Acclimate materials to installation conditions for seventy two hours prior to installation.

E. Protect packaged adhesive from temperature cycling.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

B. Do not install acoustical wall units until space has been enclosed and is watertight, wet work is complete and dry and adjacent and related work is completed.

C. Do not install acoustical wall treatment until ambient temperature and humidity level will be continuously maintained at conditions indicated for Owner occupancy.

1.11 SEQUENCING

A. Section 01 11 00 - Summary of Work: Work sequence.

B. Sequence Work to ensure acoustical units are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and accepted.

C. Install acoustic panels after interior wet work is dry.
2. PART 2  PRODUCTS

2.1  FABRIC COVERED GLASS FIBER PANELS

A.  Manufacturers:
   1.  Reference Manufacturer: Conwed - Product: Respond A
       Series acoustic wall panels.
   2.  Other Acceptable Manufacturers:
       a.  Acentus Inc.
       b.  Acoustical Resources, Inc.
       c.  Custom Acoustical Products, Inc.
       d.  ESSI Acoustical Products Company.
       e.  Golterman & Sabo, Inc.
       g.  Lamvin Inc.
       h.  Sound Concepts.
       i.  Wall Technology.
   3.  Substitutions: Section 01 60 00 - Product Requirements.

B.  Fabric Covered Glass Fiber Panels: ASTM E84, Class 1; fabric
    covered glass fiber core, straight panels conforming to the
    following:
    1.  Size: As indicated, to fit exact wall conditions.
    2.  Thickness: 1-1/2 inch.
    5.  Fabric: 100 percent polyester, color as Scheduled. Return
        on back minimum 1-1/2 inches.
    6.  NRC: Minimum 0.95.
    8.  Edge: Square, chemically hardened.

C.  Adhesive: Type recommended by panel manufacturer to suit
    substrate.
3. PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
B. Verify substrate is flat, plumb and level and ready to receive the Work of this section.
C. Verify adjacent and related work is complete.

3.2 INSTALLATION

A. Apply adhesive to panel surfaces immediately prior to application. Provide temporary support until adhesive has reached initial set.
B. Apply wall panels without gaps, butt edges tight, align vertical joints with building elements. Ensure full bond to substrate surface.

3.3 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.
B. Maximum Variation from True Flat: 1/8 inch in 10 ft.
C. Maximum Variation from Plumb of Edges: 1/8 inch in 10 feet.
D. Maximum Variation in Joint Width Between Panels: 1/16 inch.

3.4 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
B. Clean excess adhesive from walls.
3.5 SCHEDULE

A. Sound-Absorbing Wall Units:
   1. Fabric Covered Glass Fiber Panels: 4 colors for Project, as selected.

END OF SECTION
1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   2. Field application of paints, stains, varnishes, and other coatings.

B. Related Requirements:
   1. Section 05 50 00 - Metal Fabrications: Shop primed items.
   2. Section 08 12 13 - Hollow Metal Frames: Shop primed items.
   3. Section 09 96 00 - High-Performance Coatings.

1.2 REFERENCE STANDARDS

A. ASTM International:

1.3 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in section.

B. Dry Film Thickness (DFT): Depth of cured film, expressed in mils (0.001 inch).

C. Flat: Lusterless or matte finish with gloss range below 15 when measured at an 85-degree meter.

D. Semigloss: Medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data on finishing products, block fillers, and primers.
   1. Provide manufacturer's technical information including label analysis and instructions for handling, storage, and application of each material proposed for use.
   2. List each material and cross-reference the specific coating, finish system, and application. Identify each material by the manufacturer's catalog number and general classification.

C. Samples:
   1. Submit one set of paper chip samples, 1 x 2 inches in size illustrating range of colors available for each surface finishing product scheduled for Architect/Engineer's initial selection of colors.
   2. Submit two painted samples, 12 x 12 inches in size, illustrating selected colors and textures for each color and system selected with specified coats cascaded. Submit on white cardboard.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout submittals.

B. Operation and Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

C. Warranty: Submit manufacturer’s warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section.

B. Applicator: Company specializing in performing Work of this Section.
C. Single-Source Responsibility: Provide primers and undercoat paint produced by the same manufacture as the finish coats.

1.7 MOCKUP
A. Section 01 40 00 - Quality Requirements: Mockup requirements.
B. Construct mockup panels, in sizes as directed, illustrating each coating color scheme, texture, and finish.
C. Locate where directed by Architect/Engineer.
D. Incorporate accepted mockup as part of Work.

1.8 PRE-INSTALLATION MEETING
A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
B. Convene minimum one week prior to commencing Work of this Section.

1.9 DELIVERY, STORAGE, AND HANDLING
A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
C. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, VOC content, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
D. Paint Materials: Store at minimum ambient temperature of 45 degrees F and maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.
1.10 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint product manufacturer.

C. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

D. Minimum Application Temperature for Varnish and Urethane Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 foot candles measured mid-height at substrate surface.

1.11 SEQUENCING

A. Section 01 11 00 - Summary of Work: Work sequence.

B. Sequence application to the following:
   1. Do not apply finish coats until paintable sealant is applied.
   2. Back prime wood trim before installation of trim.

1.12 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Supply 1 gallon of each color, type, and surface texture; store where directed.

C. Label each container with color, type, texture, and room locations in addition to the manufacturer's label.
2. PART 2 PRODUCTS

2.1 PAINTING AND COATING

A. Manufacturers - Paints and Coatings:
2. Other Acceptable Manufacturers:
   a. Benjamin Moore and Co.
   b. Diamond Vogel Paint Company.
   c. Glidden Professional and Devoe Coatings.
   d. The Sherwin-Williams Company.
3. Substitutions: Section 01 60 00 - Product Requirements.

2.2 COMPONENTS

A. Coatings: Ready mixed. Prepare pigments:
   1. To soft paste consistency, capable of being readily and uniformly dispersed to homogeneous coating.
   2. For good flow and brushing properties.
   3. Capable of drying or curing free of streaks or sags.

B. Block fillers, primers, finish coat materials, and related materials shall be compatible with one another and substrates they are applied to.

C. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified; commercial quality.


3. PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify surfaces and substrate conditions are ready to receive Work as instructed by product manufacturer.
C. Examine surfaces scheduled to be finished prior to commencement of Work. Report conditions capable of affecting proper application.

D. Test shop applied primer for compatibility with subsequent cover materials.

E. Measure moisture content of surfaces using electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Plaster and Gypsum Wallboard: 12 percent.
   2. Concrete Unit Masonry: 12 percent.
   3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

3.2 PREPARATION

A. Surface Appurtenances: Remove electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

B. Surfaces: Correct defects and clean surfaces capable of affecting work of this section. Remove or repair existing coatings exhibiting surface defects.

C. Marks: Seal with shellac marks which may bleed through surface finishes.

D. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

E. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.


G. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
H. Concrete Unit Masonry Surfaces Scheduled to Receive Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.

I. Plaster Surfaces: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.


K. Interior Wood Items Scheduled to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats.

3.2 EXISTING WORK

A. Extend existing paint and coating installations using materials and methods compatible with existing installations and as specified at patched, repaired, and filled-in surfaces.

B. Where patch painting or painting of existing surfaces are required, finish all of individual wall and ceiling surfaces, corner to corner including equipment and fittings not specifically indicated.

C. Exposed-to-view patched, repaired, filled-in surfaces, and existing metal door frames scheduled to receive new metal doors shall be painted whether specifically indicated in Room Finish Keys, or not.

D. Refer to Room Finish Keys on Drawings and Painting Schedule for surfaces to be painted.

E. On previously painted surfaces indicated to be painted, sand and scrape to remove loose primer and paint at patches and repairs. Feather edges to make touch-up patches inconspicuous. Prime all previously painted surfaces, including patched and repaired areas with primer.
F. On previously unpainted surfaces proceed the same as for new surfaces.

G. Existing Metal Doors and Frames: Existing doors and frames located in renovation areas scheduled to be painted shall be painted whether they are specifically indicated in Roof Finish Keys and Plan Notes, or not. Prepare existing doors and frames by sanding and scraping to remove loose primer and paint. Feather edges to make patched areas inconspicuous. Clean surface with solvent. Prime previously painted steel surfaces and patched areas as noted above.

H. Existing Metal Railings, Guardrails, and Stair Components: Existing metal railings, guardrails, and stair components located in renovation areas scheduled to be painted shall be painted whether they are specifically indicated in Roof Finish Keys and Plan Notes, or not. Prepare existing surfaces by sanding and scraping to remove loose primer and paint. Feather edges to make patched areas inconspicuous. Clean surface with solvent. Prime previously painted steel surfaces and patched areas as noted above.

3.3 PROTECTION

A. Protect elements surrounding Work of this section from damage or disfiguration.

B. Repair damage to other surfaces caused by Work of this section.

C. Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.

3.4 APPLICATION

A. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

B. Apply each coat to uniform finish. Finish coats shall be smooth, free of brush marks, streaks, laps or pile up of paints and skipped or missed areas.

C. Apply each coat to uniform appearance. Apply each coat of paint slightly darker than preceding coat unless specified otherwise.
D. Metal doors and frames shall be painted using a High Volume Low Pressure (HVLP) 'cup' sprayer; paint application by brush or roller not permitted.

E. Sand surfaces lightly between coats to achieve required finish; remove defects visible from a distance of 5 feet.

F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

G. Where clear finishes are required, tint fillers to match wood. Work fillers into grain before set. Wipe excess from surface.

H. Apply primer on work before glazing proceeds.

I. Refinish whole wall where portion of finish has been damaged or is not acceptable.

J. Finishing Mechanical and Electrical Equipment:
1. Paint shop primed equipment.
2. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
3. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, except where items are prefinished.
4. Paint interior surfaces of air ducts, and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint, to visible surfaces. Paint dampers exposed behind louvers, grilles, and baseboard cabinets to match face panels.
5. Paint exposed conduit and electrical and mechanical equipment occurring in finished areas including remodel areas where no other finish work is indicated, if over previously painted surfaces.
6. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
7. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.
3.5 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Promptly remove spilled, splashed, and spattered paint as it occurs.

C. Collect waste material which may constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.6 ITEMS NOT TO BE PAINTED

A. Painting is not required unless indicated in Room Finish Keys on Drawings.

B. Painting is not required on prefinished items, finished metal surfaces, concealed surfaces, operating parts, and labels.
   1. Prefinished items not to be painted include the following factory-finished components:
      a. Toilet partitions.
      b. Acoustic ceiling panels and suspension systems.
      c. Plastic laminate clad casework and countertops.
      d. Markerboards and tackboards.
      e. Ceramic tile.
      f. Finished mechanical and electrical equipment.
      g. Light fixtures.
      h. Switchgear.
      i. Distribution cabinets.
   2. Concealed surfaces not to be painted include wall or ceiling surfaces in the following inaccessible areas:
      a. Foundation spaces.
      b. Ceiling plenum spaces.
      c. Furred areas.
      d. Pipe spaces.
   3. Finished metal surfaces not to be painted include:
      a. Anodized aluminum.
      b. Stainless steel.
      c. Chromium plate.
4. Operating parts not to be painted include moving parts of operating equipment, such as the following:
   a. Valve and damper operators.
   b. Linkages.
   c. Sensing devices.
   d. Motor and fan shafts.
5. Labels: Do not paint over Underwriter's Laboratories, Factory Mutual or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

3.7 ITEMS TO BE PAINTED

A. Listings of surfaces in Painting and Finishing Schedules are inclusive for materials and items to be painted under this section. Exceptions are listed in the preceding Article.

3.8 INTERIOR PAINT SCHEDULE

A. Concrete Unit Masonry: Provide the following finish systems over interior concrete unit masonry:
   1. Example Surfaces: Walls.
   2. Semigloss Alkyd-Enamel Finish: Two finish coats over a filled surface.
      a. Block Filler:
         DFT: 6.0 to 12.5 mils, minimum.
      b. Finish Coat:
         PPG: Speedhide WB Alkyd Semi-Gloss Enamel 6-1510.
         DFT: 1.5 mils per coat, minimum.
B. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:
   1. Example Surfaces: Walls.
   2. Semigloss Alkyd-Enamel Finish: Two finish coats over a primer.
      a. Primer:
         PPG: Speedhide Pro-EV Latex Primer 12-900.
         DFT: 1.0 mil, minimum.
      b. Finish Coats:
         PPG: Speedhide WB Alkyd Semi-Gloss Enamel 6-1510.
         DFT: 1.5 mils per coat, minimum.

C. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:
   1. Example Surfaces: Ceilings, Soffits.
   2. Flat Acrylic Finish: Two finish coats over a primer.
      a. Primer:
         PPG: Speedhide Pro-EV Latex Primer 12-900.
         DFT: 1.0 mil, minimum.
      b. Finish Coats:
         PPG: Speedhide Pro-EV Latex Flat Paint 12.110.
         DFT: 1.2 mils per coat, minimum.

D. Plaster: Provide the following finish over interior plaster surfaces:
   1. Example Surfaces: Walls.
   2. Semigloss Alkyd-Enamel Finish: Two finish coats over a primer.
      a. Primer:
         PPG: Speedhide Pro-EV Latex Primer 12-900.
         DFT: 1.0 mil, minimum.
      b. Finish Coats:
         DFT: 1.5 mils per coat, minimum.
E. **Ferrous Metal:** Provide the following finish systems over interior ferrous metal surfaces.
   1. **Example Surfaces:** Metal fabrications, steel doors and frames, wood door glazing stops, fabrications, cabinets, pipes, panels, hangers, railings, guardrails, and stair components.
   2. **Semigloss Alkyd-Enamel Finish:** Two finish coats over a primer.
      a. **Primer:**
         PPG: 6-208 Pittsburgh Paints Industrial Rust Inhibitive Steel Primer.
         DFT: 1.5 mils, minimum.
      b. **Finish Coats:**
         PPG: Speedhide WB Alkyd Semi-Gloss Enamel 6-1510.
         DFT: 1.5 mils per coat, minimum.

F. **Zinc-Coated Metal:** Provide the following finish systems over interior zinc-coated metal surfaces:
   1. **Example Surfaces:** Ducts, boxes, conduits, hangers.
   2. **Semigloss Alkyd-Enamel Finish:** Two finish coats over a primer.
      a. **Primer:**
         PPG: 6-208 Interior/Exterior Primer.
         DFT: 3.0 mils, minimum.
      b. **Finish Coats:**
         PPG: Speedhide WB Alkyd Semi-Gloss Paint 6-1510.
         DFT: 1.5 mils per coat, minimum.

G. **All-Service Jacket Over Insulation:** Provide the following finish system on cotton or canvas insulation covering:
   1. **Example Surfaces:** Exposed-to-view duct and pipe insulation.
   2. **Flat Acrylic Finish:** Two finish coats over primer. Add fungicidal agent to render fabric mildew proof.
      a. **Primer:** Provide manufacturer's recommended compatible primer if plastic jackets or elbows are provided.
      b. **Finish Coats:**
         PPG: Speedhide Pro-EV Latex Flat Paint 12-110.
         DFT: 1.0 mils per coat, minimum.
3.9 INTERIOR WOOD STAIN SCHEDULE

A. Stained Woodwork: Provide the following stained finishes over interior woodwork:
   1. Alkyd-Based Stain Satin-Varnish Finish: Two finish coats of alkyd-based clear satin varnish over a sealer coat and interior wood stain. Wipe wood filler before applying stain.
      a. Example Surfaces: Wood doors.
      b. Filler Coat:
         PPG: Not required.
      c. Stain Coat:
         PPG: DEFT DFT400 Interior Oil-Based Wood Stain.
      d. Sealer Coat:
         PPG: DEFT DFT60 Interior Oil-Based Sanding Sealer.
      e. Finish Coats:
         PPG: DEFT DFT127 Interior Oil-Based Polyurethane.

3.10 COLOR SCHEDULE

A. Interior Paint Colors:
   1. Field Colors: 4 for Project, as selected.
      a. Accent Colors: 1 accent wall (longest wall if unequal lengths) in each Classroom and Special Activity Room for Project.
   2. Trim Colors: 2 for Project, as selected.

B. Interior Stain Colors: 1 color for Project, to match existing wood door color.

END OF SECTION
1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Special preparation of surfaces.
   2. High performance coatings.

B. Related Requirements:
   1. Section 09 90 00 - Painting and Coating.

1.2 DEFINITIONS

A. Dry Film Thickness (DFT): Depth of cured film, expressed in mils (0.001 inch).

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data indicating coating materials.

C. Samples:
   1. Submit one set of paper chip samples, 1 x 2 inches in size, illustrating range of colors available for each surface finish product Scheduled, for Architect/Engineer’s initial selection of colors.
   2. Submit two painted samples, 12 x 12 inches in size, illustrating selected colors and textures with specified coats cascaded. Submit on white cardboard.
1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout submittals.

B. Operation and Maintenance Data: Submit maintenance and cleaning requirements for coatings, and repair and patching techniques.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section.

B. Applicator: Company specializing in performing Work of this Section.

1.6 MOCKUP

A. Section 01 40 00 - Quality Requirements: Mockup requirements.

B. Construct mockup, of sizes as directed by Architect/Engineer, illustrating coatings, colors, surface sheens, and textures, for each coating specified.

C. Locate where directed by Architect/Engineer.

D. Incorporate accepted mockup as part of Work.

1.7 PRE-INSTALLATION MEETING

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing Work of this Section.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Do not install materials when temperature is below 55 degrees F or above 90 degrees F.
C. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.

D. Provide lighting level of 80 foot candles measured mid-height at substrate surface.

E. Restrict traffic from area where coating is being applied or is curing.

2. PART 2 PRODUCTS

2.1 HIGH-PERFORMANCE COATINGS

A. Manufacturers - Moderate Exposure:
   2. Other Acceptable Manufacturers:
      b. Diamond Vogel Paint Company (DV).
      c. Glidden Professionals and Devoe Coatings (GP).
      d. The Sherwin-Williams Company (SW).
   3. Substitutions: Section 01 60 00 - Product Requirements.

B. Manufacturers - Severe Exposure:
   1. Reference Manufacturer: Tnemec Company (TN).
   2. Substitutions: Section 01 60 00 - Product Requirements.

2.2 COMPONENTS

A. Coatings - General: Furnish complete multi-coat systems formulated and recommended by manufacturer for applications indicated, in number of coats and thicknesses Scheduled.
   1. Lead Content: None.
   2. Chromium Content: As zinc chromate or strontium chromate; none.
   3. Maximum VOC Content: As required by applicable regulations.
   4. Colors: As Scheduled.

B. Masonry Filler: As recommended by high performance coating manufacturer; vehicle and resin compatible with top coats; portland cement and sand, formulated for applied thickness of 30-40 mils.
C. Latex Filler: As recommended by high performance coating manufacturer; compatible with primer and finish coats; latex based gypsum patching compound.

D. Primer, block filler, and finish coat materials and related materials shall be compatible with one another and the substrates they are applied to.

3. PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify substrate surfaces are ready to receive Work as instructed by coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.

C. Verify paintable joint sealers have been installed and cured 14 days, minimum.

D. Cementitious Substrates: Do not begin application until substrate has cured 28 days minimum and measured moisture content is not greater than 16 percent.

E. Masonry: Verify masonry joints are struck flush.

3.2 PREPARATION

A. Clean surfaces of loose foreign matter.

B. Remove substances that would bleed through finished coatings. When removal is not possible, seal surfaces as recommended by coating manufacturer.

C. Remove finish hardware, fixture covers, and accessories and store.

D. Field prepare substrate surfaces as Scheduled.
E. Protect adjacent surfaces and materials not receiving coating from overspray; mask if necessary to provide adequate protection. Repair damage.

3.3 EXISTING WORK

A. Extend existing high performance coating installations using materials and methods compatible with existing installations and as specified at patched, repaired, and filled-in surfaces.

B. Where patch coating or coating of existing surfaces are required, finish all of individual wall and ceiling surfaces, corner to corner, including equipment and fittings not specifically indicated.

C. Exposed-to-view patched, repaired, and filled-in surfaces shall be coated whether specifically indicated in Room Finish Keys, or not.

D. Refer to Room Finish Keys on Drawings and High Performance Coating Schedules for surfaces to be coated.

E. On previously coated surfaces, coat patches and repairs with primer before proceeding with scheduled finish coats.

F. On previously uncoated surfaces proceed with same as for new surfaces.

3.4 INSTALLATION

A. Apply primer, block filler, and finish coats to substrate surfaces in number of coats and minimum DFT thicknesses as Scheduled.

B. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness. Back roll surfaces to fill pin holes.

3.5 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Collect waste material which may constitute fire hazard, place in closed metal containers, and remove daily from site.
C. Clean surfaces immediately of overspray, splatter, and excess material.

D. After coating has cured, clean and replace finish hardware, fixtures, and fitting previously removed.

3.6 INTERIOR HIGH PERFORMANCE COATING SCHEDULE

A. Gypsum Board: Provide the following coating system over interior gypsum board substrates:
   1. Example Surfaces: Walls.
   2. Field Surface Preparation: Apply latex filler to thickness required to fill minor indentations and surface imperfections and produce smooth surface.
   3. Coating System: Two finish coats over a primer.
         PPG: Seal-Grip Universal Primer 17-921XI.
         DFT: 1.5 to 2.0 mils, minimum.
      b. Finish Coats: Waterborne pre-catalyzed acrylic epoxy; semigloss finish.
         DFT: 2.0 to 3.0 mils per coat, minimum.

B. Concrete Unit Masonry: Provide the following coating system over interior concrete unit masonry substrates:
   1. Example Surfaces: Walls.
   2. Field Preparation: Apply masonry filler to thickness required to fill bug holes and produce smooth surface.
   3. Coating System: Two finish coats over a block filler.
         PPG: SpeedHide 6.15XI Interior/Exterior Masonry Latex Hi-Fill Block Filler.
         DFT: 9.0 to 19.0 mils, minimum.
      b. Finish Coats: Waterborne pre-catalyzed acrylic epoxy; semigloss finish.
         DFT: 2.0 to 3.0 mils per coat, minimum.
C. Gypsum Plaster: Provide the following coating system over interior gypsum plaster substrates:
   1. Example Surfaces: Walls.
   2. Field Preparation: Apply masonry filler to thickness required to fill bug holes and produce smooth surface.
   3. Coating System: Two finish coats over a block filler.
         PPG: SpeedHide 6.15XI Interior/Exterior Masonry Latex Hi-Fill Block Filler.
         DFT: 9.0 to 19.0 mils, minimum.
      b. Finish Coats: Waterborne pre-catalyzed acrylic epoxy; semigloss finish.
         DFT: 2.0 to 3.0 mils per coat, minimum.

D. Existing Glazed Masonry: Provide the following coating system over interior glazed masonry substrates:
   1. Example Surfaces: Walls.
   2. Field Preparation: Hand grind glazed surfaces to create aggressive anchor profile and de-gloss surface in accordance with manufacturer’s recommendations. Clean and dry surfaces before proceeding with primer and finish coating.
   3. Coating System: One finish coat over a primer.
      a. Primer: Two component field catalyzed modified aliphatic amine epoxy.
         TN: Ceramlon ENV Series 84.
         Coverage: 140 - 160 sq ft/gallon.
      b. Finish Coat: Two component field catalyzed modified aliphatic amine epoxy; semi-gloss finish.
         TN: Ceramlon ENG Series 84.
         Coverage: 140 - 160 sq ft/gallon.
3.7 COLOR SCHEDULE

A. Interior Coating Colors:
   1. Gypsum Board: 2 colors for Project, as selected.
   2. Concrete Unit Masonry: 2 colors for Project, as selected.
   3. Gypsum Plaster: 2 colors for Project, as selected.
   4. Glazed Masonry: 2 colors for Project, as selected.

END OF SECTION
SECTION 10 11 00

VISUAL DISPLAY SURFACES

1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Markerboards.
   2. Tackboards.

B. Relates Requirements:
   1. Section 04 20 00 - Unit Masonry: Substrate construction.
   2. Section 06 10 53 - Miscellaneous Rough Carpentry: Wood grounds.

1.2 REFERENCE STANDARDS

A. American National Standards Institute:
   1. ANSI A135.4 - Basic Hardboard.
   2. ANSI A208.1 - Mat-Formed Wood Particleboard.

B. ASTM International:

C. Federal Specification Unit:
   1. FS CCC-W-408 - Wall Covering, Vinyl-Coated.

D. Porcelain Enamel Institute:
   1. PEI - Performance Specifications for Porcelain Enamel Chalkboards.
1.3 SUBMITTALS
   A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
   B. Shop Drawings: Indicate wall elevations, dimensions, joint locations, and special anchor details.
   C. Product Data: Submit data on markerboards, tackboards, tackboard surface coverings, and accessories.
   D. Samples: Submit two sets of samples for Architect/Engineer’s selection of visual display board colors.

1.4 CLOSEOUT SUBMITTALS
   A. Section 01 70 00 - Execution and Closeout Requirements: Closeout submittals.
   B. Operation and Maintenance Data: Submit data on regular cleaning and stain removal.
   C. Warranty: Submit manufacturer’s warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE
   A. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.6 QUALIFICATIONS
   A. Manufacturer: Company specializing in manufacturing Products specified in this Section.

1.7 FIELD MEASUREMENTS
   A. Verify field measurements prior to fabrication.
1.8 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish ‘Life of Building’ manufacturer warranty for visual display boards.

C. Warranty: Include coverage of markerboard and marker wall surfaces from discoloration due to cleaning, crazing or cracking, or staining.

2. PART 2 PRODUCTS

2.1 VISUAL DISPLAY SURFACES

A. Manufacturers:
   1. Reference Manufacturer: Claridge Products and Equipment Inc. - Products: As Scheduled.
   2. Other Acceptable Manufacturers:
      a. Carolina Chalkboard.
      b. Greensteel.
      c. ADP Lemco, Inc.
      d. Nelson Adams NACO.
      e. Platinum Visual Systems.
      f. W.E. Neal Slate Co.
   3. Substitutions: Section 01 60 00 - Product Requirements.

2.2 COMPONENTS

A. Sheet Steel: ASTM A424, Type I, commercial quality.

B. Cork: Fine grain natural cork, homogeneous composition.


D. Hardboard: ANSI A135.4, tempered, smooth face.

E. Particle Board: ANSI A208.1, wood chips set with waterproof resin binder, sanded faces.

F. Aluminum Backing: Aluminum sheet, 0.015 inch thick.
2.3 ACCESSORIES

A. Adhesives: Waterproof type.

B. Map Supports: Formed aluminum sliding hooks, to fit map rail. Furnish 1 hook for each 2 feet of map rail.

C. Temporary Protective Cover: Sheet polyethylene, 8 mil thick.

D. Cleaning Instruction Plate: Provide instructions for [chalkboard and] markerboard cleaning on plastic plate fastened to perimeter frame near chalkrail.

2.4 FABRICATION

A. Fabrication - Markerboards:
   1. Provide factory assembled markerboard units.
   2. Outer Face Sheet: Steel, 24 gage thick.
   3. Core: Particle board, 3/8 inch thick.

B. Fabrication - Tackboards:
   1. Provide factory assembled tackboard units.
   3. Core: Cork, 1/4 inch thick.
   4. Backing Surface: Hardboard, 1/4 inch thick.

C. Fabrication - Frame and Trim:
   1. Aluminum Frame: Of hollow profile; concealed fasteners, map rail with cork insert over markerboard and tackboard surfaces.
   2. Aluminum Chalkrail: Of hollow profile with sloping bottom, one piece full length of markerboard, closed ends; concealed fasteners.

2.5 FACTORY FINISHING

A. Porcelain Enamel: Glass fibered enamel, baked to vitreous surfaces, high gloss; Porcelain Enamel Institute Type A; color as Scheduled.
B. Tackboard Surface: Vinyl, color as Scheduled.

C. Aluminum Frame, Chalkrail, and Accessories: Anodized to clear satin finish.

3. **PART 3  EXECUTION**

3.1 **EXAMINATION**

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify internal wall blocking is ready to receive Work and positioning dimensions are as indicated on Shop Drawings.

3.2 **INSTALLATION**

A. Establish top of chalk rail or bottom of perimeter frame at elevations indicated on shop drawings.

B. Secure units level and plumb.

3.3 **CLEANING**

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Clean visual display boards in accordance with manufacturer’s instructions.

C. Cover tackboard and markerboard surfaces with protective cover, taped to frame.

D. Remove temporary protective cover at date of Substantial Completion.
3.4 SCHEDULE

A. Visual Display Boards:
   1. Markerboards: LCS markerboard, Series 1 trim and chalkrail for factory built markerboards; locations and sizes as indicated; 1 color for Project, as selected.
   2. Tackboards: Fabricork Vinyl tackboards; Series 1 trim for factory built tackboards; locations and sizes as indicated; 2 colors for Project, as selected.

END OF SECTION
SECTION 10 21 13.19
PLASTIC TOILET COMPARTMENTS

1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Solid plastic toilet compartments.
   2. Urinal screens.

B. Related Requirements:
   1. Section 06 10 53 - Miscellaneous Rough Carpentry:
      Concealed wood blocking for compartment support.
   2. Section 10 28 00 - Toilet, Bath, and Laundry Accessories.

1.2 REFERENCE STANDARDS

A. ASTM International:
   1. ASTM A666 - Standard Specification for Austenitic Stainless
      Steel Sheet, Strip, Plate, and Flat Bar.

1.3 PREINSTALLATION MEETING

A. Section 01 30 00 - Administrative Requirements: Requirements for
   preinstallation meeting.

B. Convene minimum one week prior to commencing Work of this
   Section.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for
   submittals.

B. Shop Drawings: Indicate partition plan, elevation views,
   dimensions, details of wall and floor supports, door swings.

C. Product Data: Submit data on panel construction, hardware, and
   accessories.
D. Samples: Submit two sets of samples for Architect/Engineer's selection of colors.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section.

B. Installer: Company specializing in performing Work of this Section.

1.6 EXISTING CONDITIONS

A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

2. PART 2 PRODUCTS

2.1 SOLID PLASTIC TOILET COMPARTMENTS

A. Manufacturers:
   2. Other Acceptable Manufacturers:
      a. Accurate Partitions Corp.
      b. Bradley Corporation.
      c. Columbia Partitions.
      d. General Partitions Mfg. Corp.
      e. Global Partitions.
      f. Hadrian Mfg. Inc.
      g. Metpar Corp.
   3. Substitutions: Section 01 60 00 - Product Requirements.

B. Compartments: Floor mounted, head-rail braced.

C. Door and Panel Dimensions:
   1. Thickness: 1 inch.
   2. Door Width: 24 inch.
   3. Accessible Door Width: 36 inch, out-swinging.
   4. Height: 55 inch.
D. Pilaster Dimensions:
   1. Thickness: 1 inch.
   2. Width as required to suit compartment width and spacing.

E. Urinal Screens:
   1. Wall mounted with continuous wall brackets, and floor-to-ceiling vertical upright consisting of pilaster anchored to floor and panel.
   2. Width: As indicated on Drawings.
   3. Height: 55 inch.

2.2 MATERIALS

A. Toilet Components: Solid, molded thermoset, and waterproof; high-density polyethylene (HDPE) plastic panels, doors, and pilasters.
   1. Colors: As Scheduled.

2.3 ACCESSORIES

A. Pilaster Shoe:
   1. Formed ASTM A666 Type 304 stainless steel with No. 4 finish, 3 inch height to conceal floor fastenings.
   2. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.

B. Head Rails: Hollow anodized aluminum tube, with anti-grip profiles and cast socket wall brackets.

C. Heat Sinks: Anodized aluminum, to clear color; provide at bottom of doors and partitions.

D. Brackets: Anodized aluminum.

E. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
   1. For Attaching Panels and Pilasters to Brackets: Trough-bolts and nuts; tamper-proof.

F. Hardware: Polished chrome-plated, non-ferrous cast metal.
   1. Pivot hinges, gravity type, adjustable for door-close positioning; two for each door.
   2. Nylon bearings.
   3. Slide bolt door latch with exterior emergency access feature.
4. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
5. Coat hook with rubber bumper; one for each compartment, mounted on door.
6. Door pull for out-swinging doors; two for each door, one mounted on each side of door.
7. Door stop and rubber bumper for out-swinging doors; one for each door, mounted on wall.

3. PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for installation examination.
B. Verify field measurements are as indicated on Shop Drawings.
C. Verify correct spacing of and between plumbing fixtures.
D. Verify correct location of built-in framing, anchorage, and bracing.

3.2 INSTALLATION

A. Maintain maximum of 1/2 inch space between wall and panels and between wall and end pilasters.
B. Attach heat sinks to panel and door bottoms.
C. Attach panels brackets securely to walls using anchor devices.
D. Attach panels and pilasters to brackets. Locate head-rail joints at pilaster center lines.

3.3 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.
B. Maximum Variation From Indicated Position: 1/4 inch.
C. Maximum Variation From Plumb: 1/8 inch.
3.4 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for inspecting.

B. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.5 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for adjusting.

B. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.

C. Adjust hinges to position doors in partially opened position when unlatched. Return out-swinging doors to closed position.

D. Adjust adjacent components for consistency of line or plane.

3.6 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Clean partition and screen surfaces with materials and cleansers according to manufacturer’s recommendations.

3.7 SCHEDULE

A. Plastic Toilet Compartments:
   1. Toilet Rooms: Toilet compartments and urinal screens; locations and sizes as indicated; 2 colors for Project, as selected.

END OF SECTION
SECTION 10 21 23
CUBICLES

1. PART 1 GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Surface mounted overhead metal curtain track and guides.
   2. Curtains.
B. Related Requirements:
   1. Section 09 51 13 - Acoustical Panel Ceilings: Suspended ceiling system to support track.

1.2 REFERENCE STANDARDS
A. National Fire Protection Association:

1.3 PERFORMANCE REQUIREMENTS
A. Track: Support vertical test load of 50 lbs without visible deflection of track or damage to supports.
B. Track Size: Safely support moving loads.
C. Track and Mounting: Sufficiently rigid to resist visible deflection and without permanent set.

1.4 SUBMITTALS
A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
B. Shop Drawings: Indicate reflected ceiling plan view of curtain track, hangers and suspension points, attachment details, and schedule of curtain sizes.
C. Product Data: Submit data for curtain fabric characteristics.
D. Samples:
   1. Submit two sets of samples for Architect/Engineer's selection of colors.
   2. Submit 12 x 12 inch sample patch of curtain cloth with representative hem stitch detail, heading with reinforcement, and carrier attachment to curtain header.
   3. Submit 12 inch sample length of curtain track including typical splice and ceiling hanger.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout submittals.

B. Operation and Maintenance Data: Submit recommended cleaning methods and materials and stain removal methods.

1.6 QUALITY ASSURANCE

A. Flame Resistant Fabric: Passes when tested in accordance with NFPA 701, Test 1 or Test 2.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

2. PART 2 PRODUCTS

2.1 CUBICLES

A. Manufacturers:
   1. Reference Manufacturer: C/S General Cubicle - Products: As Scheduled.
   2. Other Acceptable Manufacturers:
      a. Imperial Fastener Company.
      b. InPro Corporation.
      c. Salsbury Industries.
   3. Substitutions: Section 01 60 00 - Product Requirements.
2.2 COMPONENTS

A. Track: Extruded aluminum sections; one piece for each cubicle track run; C-shaped profile.

B. Track End Stops and Radius: To fit track section.

C. Curtain Carriers: Nylon roller to accurately fit track; designed to eliminate bind when curtain is pulled; fitted to curtain to prevent accidental curtain removal; 2 carriers for each 12 inches of fabric width.

D. Curtain: Polyester reinforced vinyl; anti-bacterial, self deodorizing, sanitized, preshrunk, flame resistant treated. Color as Scheduled.

E. Open Mesh Cloth: Open weave nylon mesh to permit air circulation; flameproof material; white color.

2.3 FABRICATION

A. Manufacturer curtains of one piece, sized 10 percent wider than track length. Terminate curtain 15 inches from floor.

B. Include open mesh cloth at top 21 inches of curtain for room air circulation.

C. Curtain Heading: Triple thickness 1-1/2 inches wide, with metal grommet holes for carriers spaced 6 inches on center, double fold bottom hem 1 inch wide. Lock stitch seams in two rows. Turn seam edges and lock stitch.

D. Fabricate track bend with minimum 12 inch radius, without deforming track section, or impeding movement of carriers.

2.4 FACTORY FINISHING

A. Exposed Surfaces: Clear anodized finish.
3. PART 3  EXECUTION

3.1  EXAMINATION

A.   Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B.   Verify suspended ceiling system are ready to receive Work.

3.2  INSTALLATION

A.   Install curtain track secure and rigid, true to ceiling line.

B.   Install end cap and stop device.

C.   Secure track to ceiling system.

D.   Install curtains on carriers ensuring smooth operation.

3.3  SCHEDULE

A.   Cubicles:

1.   Nurse 111: Surface mounted; 6062 surface mounted track, #1062N carriers, Mesh "B" top, Sure Check curtain; 1 color for Project, as selected.

END OF SECTION
SECTION 10 28 00

TOILET, BATH, AND LAUNDRY ACCESSORIES

1. PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Toilet accessories.

B. Related Requirements:
   1. Section 01 11 00 - Summary or Work: Toilet tissue dispensers, paper towel dispensers, and soap dispensers furnished by Owner and installed by Contractor.
   2. Section 09 21 16 - Gypsum Board Assemblies: In-wall framing and backer plates for support of accessories.

1.2 REFERENCE STANDARDS

A. ASTM International:
   4. ASTM A653 - Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process.
   5. ASTM A666 - Standard Specification for Annealed or Cold Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
1.3 COORDINATION
A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
B. Coordinate Work of this Section with placement of internal wall reinforcement to receive anchor attachments.

1.4 SUBMITTALS
A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

1.5 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing Products specified in this Section.
B. Installer: Company specializing in performing Work of this Section.

1.6 WARRANTY
A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
B. Furnish fifteen-year manufacturer’s warranty for mirror glass.
2. PART 2 PRODUCTS

2.1 TOILET AND BATH ACCESSORIES

A. Manufacturers - Toilet and Bath Accessories:
   2. Other Acceptable Manufacturers:
      a. American Specialties, Inc.
      b. Bradley Corporation.
   3. Substitutions: Section 01 60 00 - Project Requirements.

B. Performance and Design Criteria:
   1. Design grab bars and attachments to resist minimum 250 lb concentrated load applied at any point in any direction.

2.2 MATERIALS

A. Accessories: Shop assembled, free of dents and scratches, and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
   1. Grind welded joints smooth.
   2. Fabricate units made of metal sheet of seamless sheets with flat surfaces.

B. Keys: Furnish 2 keys for each keyed accessory to Owner; key all doors and cabinets alike; key coin boxes differently. Master key all accessories.

C. Stainless Steel Sheet: ASTM A666, Type 304.

D. Stainless Steel Tubing: ASTM A269, Type 304.

E. Galvanized Sheet Steel: ASTM A653, G90 zinc coating.

F. Mirror Glass: ASTM C1036, Type 1 transparent flat, Class 1 clear, Quality Q1 mirror select; type with copper and silver coating and organic overcoating.

G. Fasteners, Screws, and Bolts: Hot-dip galvanized, tamper-proof.

H. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.
2.3 FINISHES

A. Stainless Steel: No. 4 satin brushed finish, unless otherwise noted.

B. Chrome/Nickel Plating: ASTM B456, Type SC 2, satin finish, unless otherwise noted.

C. Galvanizing for Items other than Sheet: ASTM A123; hot-dip galvanize after fabrication.


E. Back paint components where contact is made with building finishes to prevent electrolysis.

2.4 TOILET ROOM ACCESSORIES

A. Framed Mirror:
   1. Frame: 18-8 S, Type 304, heavy-gage stainless steel, 3/4" x 3/4" angle with vertical-grain satin finish. One-piece, roll-formed construction forms continuous integral stiffener on all sides. Bevel design on front of angle holds frame tightly against mirror. Corners of mirror frame are heliarc welded, ground and polish smooth. Galvanized steel back is fastened to frame with concealed screws and equipped with integral horizontal hanging brackets near top and bottom of mirror for hanging mirror and to prevent mirror from pulling away from wall. Locking devices secure mirror to concealed wall hanger. Concealed Philips-head locking screws securely fasten mirror to wall hanger.
   2. Mirror: Q1 quality, 1/4" select float glass (standard glass); selected for silvering, electrolytically copper-plated by galvanic process. All edges protected by plastic filler strips; back is protected by full-size, shock-absorbing, water-resistant, nonabrasive, 3/16" thick polyethylene padding.
   3. Concealed Wall Hanger: 20 gage galvanized steel. Incorporates lower support member, forming rigid rectangle, which engages lower backplate louvers to keep bottom of mirror against wall.
   4. Bobrick Model Numbers: B-290 2460 (24" wide x 60" high).
B. Grab Bar:
1. Grab Bar: 18-8 S, Type 304, 18 gage stainless steel tubing with satin finish and peened gripping surface. 1-1/2" outside diameter. Ends are heliarc welded to flanges. Clearance between grab bar and wall is 1-1/2".
2. Concealed Mounting Flanges: 18-8 S, Type 304, 1/8" thick, stainless steel plate; end flanges 2" x 3-1/8" with two holes for attachment to wall. Intermediate flanges 2-5/8" x 3-1/8" wide x 3-1/8" diameter.
3. Snap Flange Covers: 18-8 S, Type 304, 22 gage drawn stainless steel with satin finish. 3-1/4" diameter x 1/2" deep. Each cover snaps over mounting flange to conceal mounting screws.
4. Bobrick Model Numbers: B-6806.99 x 18 (18" vertical bar), B-6806.99 x 36 (36" horizontal bar), B6806.99 x 42 (42" horizontal bar).

C. Surface-Mounted Napkin/Tampon Vendor:
1. Cabinet: 18-8 S, Type 304, 18 gage stainless steel. All-welded construction.
2. Door: 18-8 S, Type 304, 18 gage stainless steel with satin finish. Door has three 90 degree return edges and hemmed bottom edge. Secured to cabinet with concealed full-length stainless steel piano-hinge. Equipped with two tumbler locks. Door has no brand-name advertising for products dispensed. Graphic symbols identify products dispensed and coin denomination.
3. Coin Mechanisms (2): Impact-resistant PC-ABS push buttons. Accepts one or two quarters as designated by factory setting. Coin mechanisms can be converted in field to any standard coin denomination without having to buy new coin mechanisms (free, 25¢, or 50¢). Coin box equipped with tumbler lock.
5. Product Tray: Impact-resistant PC-ABS, provides convenient access to dispensed product.
3. PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for installation examination.

B. Verify exact location of accessories for installation.

C. Verify field measurements and rough-in dimensions for recessed accessories are as indicated on product data.

D. Comply with Sections 09 21 16 for installation of reinforcing plates, and concealed anchors in walls.

3.2 PREPARATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Deliver inserts and rough-in frames to site for timely installation.

C. Provide templates and rough-in measurements as required.

3.3 INSTALLATION

A. Do not install accessories until after completion of all finishes to adjacent wall and ceiling surfaces.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Turn over to Owner all keys and special tools required for lockable or secured accessories.

D. Mounting Heights and Locations: As required by accessibility regulations, and as indicated on Drawings.
3.4 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Clean mirrors and exposed surfaces using procedures as recommended by accessory manufacturer.

3.5 SCHEDULE

A. Toilet, Bath, and Laundry Accessories:
   1. Toilet and Bath Accessories Schedule: Refer to following attachment.

END OF SECTION
## TOILET AND BATH ACCESSORY SCHEDULE

**PROJECT NAME:** Parkview MS Renovation & System Upgrades - Phase 2; Ankeny, IA.  
**PROJECT NO.:** 1023F01

<table>
<thead>
<tr>
<th>ITEM</th>
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<td>Paper Towel Dispensers*</td>
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<tr>
<td>Soap Dispensers*</td>
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*Toilet tissue dispensers, paper towel dispensers, and soap dispensers furnished by Owner and installed by Contractor; refer to Drawings for quantities and locations.*
### TOILET AND BATH ACCESSORY SCHEDULE

**PROJECT NAME:** Parkview MS Renovation & System Upgrades - Phase 2; Ankeny, IA.  
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Toilet tissue dispensers, paper towel dispensers, and soap dispensers furnished by Owner and installed by Contractor; refer to Drawings for quantities and locations.
SECTION 12 25 53.16
PLASTIC-LAMINATE-CLAD LABORATORY CASEWORK

1. PART 1  GENERAL

1.1  SUMMARY

A.  Section Includes:
   1.  Plastic laminate laboratory casework.
   2.  Countertops.
   3.  Sinks and sink fittings.
   4.  Service fixtures.

B.  Related Requirements:
   1.  Section 06 10 53 - Miscellaneous Rough Carpentry: Grounds and support framing.
   2.  Section 09 65 00 - Resilient Flooring: Vinyl cove base for casework.
   3.  Division 22 - Plumbing: Execution and product requirements for connecting sink fittings and service fixtures specified in this Section, including providing traps.
   4.  Division 26 - Electrical: J-boxes, electrical outlets, and faceplates.
   5.  Division 27 - Communications: J-boxes, data outlets, and faceplates.

1.2  REFERENCE STANDARDS

A.  American National Standards Institute:
   1.  ANSI A208.1 - Mat Formed Wood Particleboard.

B.  ASTM International:

C.  National Electrical Manufacturers Association:
   1.  NEMA LD3 - High Pressure Decorative Laminates.
1.3 SYSTEM DESCRIPTION

A. Plastic-Laminate-Clad Laboratory Casework: Dimensions, configurations, and functions shall conform to those indicated on Drawings.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate casework locations, large scale plans, elevations, cross sections, rough-in and anchor placement dimensions and tolerances, and hardware locations.

C. Product Data:
   1. Submit data on high-pressure plastic laminate, pressure fused laminate, epoxy resin countertop, and edging.
   2. Submit data on hardware, sinks, sink fittings, service fixtures, and accessories.

D. Samples:
   1. Submit one sample, 4 x 6 inches in size illustrating cabinet exterior and interior finishes.
   2. Submit one sample, 4 x 6 inches in size counter top finishes.
   3. Submit two set of samples for Architect/Engineer's selection of plastic laminate, and edging colors.
   4. Submit one sample pull, hinge, and lock illustrating hardware finish and style.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout submittals.

B. Product Record Documents: Record actual locations of concealed utility connections. Record actual locations of installed locks and their master key codes.

C. Operation Data: Submit description of equipment operation, adjusting, and testing required. Identify system maintenance requirements, servicing cycles, lubrication types required, and spare part sources.
D. Keys: Delivered with identifying tabs to Owner.

E. Warranty: Submit manufacturers warranty and ensure forms have been completed in Owner’s name and registered with manufacturer.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section.

B. Installer: Company specializing in performing Work of this Section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Accept casework on site. Inspect on arrival for damage.

C. Coordinate size of access and route to place of installation.

1.8 AMBIENT CONDITIONS

A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

B. Maintain storage space relative humidity within ranges recommended by manufacturer.

C. Subsequent Conditions: Maintain same temperature and humidity conditions in building spaces as will occur after occupancy during and after installation of Work of this Section.

1.9 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and Project conditions.

B. Coordinate Work with location and placement of utilities. Coordinate characteristics of utilities with requirements of laboratory casework.
C. Sequence installation to accommodate utility connections.

D. Coordinate Owner’s keying requirements during course of Work.

1.10 EXISTING CONDITIONS

A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

1.11 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout submittals.

B. Provide 3 year manufacturer warranty for laboratory casework.

C. Provide manufacturer’s standard warranties for sinks, sink fittings, and service fixtures.

2. PART 2 PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD LABORATORY CASEWORK

A. Manufacturers - Manufactured Plastic Laminate Casework:
   2. Other Acceptable Manufacturers:
      a) Case Systems.
      b) TMI Systems Design Corporation.
   3. Substitutions: Section 01 60 00 - Product Requirements.

2.2 SURFACE MATERIALS

A. Cabinets:
   1. Exposed finish ends, fronts, modesty panels, and finished backs shall be faced with PF-28 (0.028") High Pressure Laminate (HPL), tested under NEMA LD-3. Decorative laminate shall be thermostet to core using catalyzed Polyvinyl Acetate (PVA) glue with minimum 80 pounds per square inch (PSI) pressure and average 180 degrees F. Lower pressure and cold curing glue not acceptable.
   2. Panels with PF-28 surfaces shall have Cabinet Liner Surface (CLS) (0.020") interior cabinet liner.
B. Interiors:
1. Semi-exposed surfaces shall be manufacturer’s standard TF (thermo-fused) laminate two sides. Laminate shall be homogenous, thermofused to core face, resulting in panel structure warranted against delamination. Manufacturer’s standard TF laminate shall be tested under NEMA LD 3 vertical grade GP-28 standards. TF lamination shall use high pressure 350-400 PSI with thermosetting temperatures of 380-400 degrees F under precision controlled press cycle with textured surface finishes.

C. Backs: Semi-exposed backs behind doors shall be coated Maple Beige or Pearl White solid color finish coordinated to interior selection.

2.3 CORE MATERIALS

A. Particleboard: High performance industrial grade core; 45# - 48# density 3-ply type formation conforming to ANSI A208.1 and ASTM D1037 standards.

B. Medium Density Fiberboard (MDF): 48# density core conforming to ANSI A208.1 MD-130 standards.

2.4 EDGING

A. Cabinet Edges: Cabinet body sides, top, bottom, adjustable shelves, and other interior components shall be edged with 0.020" flat edge extrusion. Selections shall match laminate based on manufacturer’s standard offering and commercially available stock patterns. Automated hot melt adhesive application and trimming.

B. Door and Drawer Fronts: Edges shall have 3mm radius extrusion banding. Selections shall match laminate based on manufacturer’s standard offering and commercially available stock patterns. Fronts shall have radius edges and corners utilizing automated hot melt adhesive application and trimming.

2.5 SELECTIONS AND APPLICATIONS

A. Exposed: Cabinet finished ends, fronts, modesty panels, and finished backs HPL shall be selected from Wisonart standard offering (standard price category).
B. Semi-Exposed Interior Surfaces: Shall be selected from Pearl White solid color.

C. Drawers: Shall be Pearl White solid color coordinated to match interior selected.

D. Backs: Shall coordinate with interior selected; Pearl White solid color.

E. Countertops: Epoxy resin, Black color.

2.6 HARDWARE

A. 5-Knuckle Hinges: Heavy duty 5-knuckle 270 degree pivot reveal overlay style. Hinges shall have interlaying leaves 270 degree swing construction of 0.090" thickness steel. Hinges shall be Grade 1 with hospital ground tips and non-removeable pin. Doors 48" or less shall have 2 hinges per door. Doors exceeding 48" shall have 3 hinges per door. Hinges shall have vertical adjustment and shall be mounted with 2 - 5mm thread-in screw bolts plus 2 additional #8 screws in cabinet leaf. Door leaf shall have 2 - 5mm thread-in bolts plus 3- #8 screws. Total 9 fasteners per hinges. Mountings without 5mm thread-in screw bolt fasteners not acceptable.

B. Door Catches: Heavy duty spring loaded, large diameter (17.5mm) roller catches mounted at door bottom. Catch strike plate shall be injection molded with integral molded engagement ridge and wide face bumper door stop. Full height tall cabinet doors shall have catches at both top and bottom.

C. Pulls: Shall be easy grip 5" U-shaped, easy grip profile 8mm diameter formed wire, 5" center-to-center; one each door and drawer.
   1. Product: SA00, Bentwire 128 with Grey Chrome powder coated finish.
D. Drawer Slides:
   1. Extension slides shall be bottom and side mounted epoxy coated steel slides. Lateral stability shall be achieved through formed captive slide profile, and slides shall glide on nylon rollers. Slides shall have both in and out drawer stop with self close feature. Slides shall carry 100 pound dynamic load rating.

E. Hanger Bars: Heavy chrome plated oval tubing mounted in adjustable end wall sockets.

F. Shelf Supports: Adjustable shelf supports shall be injection molded clear polycarbonate. Supports shall incorporate integral molded lock tabs to retain shelf from tipping or inadvertent lift out. Supports shall have 5mm diameter double pin engagement into precision bored cabinet vertical hole patterns. Adjustment shall be 1-1/4" spacings. Supports shall have compression ridge effecting force against shelf edge to maintain positive pin engagement. Supports shall have molded-in screw attachment feature. Static test load shall exceed 200# per clip.

G. Locks: High security 6-tumbler lock system shall be provided on all tall cabinet doors. Locks shall have diecast body with dead bolt engagement tang; cylinder locks with attached rotating cams not acceptable. Locks shall have removable and interchangeable 6-tumbler core for easy field and Owner re-keying options. Locks shall be master keyed and available key-alike or key-different with 250 standard key changes and possibility of up to 2000 total changes where required; key tall wardrobe door locks differently, masterkey locks in each room, masterkey each room differently. Each lock shall be provided with two double bit keys and face of lock stamped with key number; in addition, provide 2 blue color coded masterkeys each room, and 2 red color coded core keys for in-field re-keying.
   1. Product: SA402 6-tumbler dead bolt lock.

2.7 COMPONENT DETAILS AND CONSTRUCTION

A. Fronts:
   1. Door and Drawer Fronts: Shall be 3/4" thick and shall have facers as indicated above. Edges shall have 3mm radius edge extrusions matching face. Automated hot melt adhesive application and trimming.
B. Wall Cabinets: Components shall be 3/4" thick members throughout. Wall cabinet tops and bottoms shall include back groove and minimum 4 dowel pins per joint for insertion into cabinet ends. Wall cabinet ends shall be 3/4" thick with back groove and precision CNC (computer numerical control) drill pattern location of fixed members, hardware, and shelf supports. Wall cabinets shall have 2 integral (dowel into end) mounting frames. Designs with simple spacer rails or rails without dowel pin engagement into ends not acceptable.

C. Wall Cabinet Bottoms Matching Exterior: Wall cabinet bottoms shall have laminate matching exterior.

D. Mounting Frames: Incorporated into wall and tall units shall be 3/4" thick with minimum 2 dowel pins per mounting frame end joint. Base units shall have 8-1/2" wide mounting frames with minimum 3 dowel pins per mounting frame end joint.

E. Tall Cabinets: Components shall be 3/4" thick members throughout. Tall cabinet tops and bottoms shall include back groove and minimum 8 total dowels per end joint (based on cabinet depth). Tall cabinet ends shall be 3/4" thick with back groove and precision CNC (computer numerical control) drill pattern for accurate location of fixed members, hardware, and shelf supports. Tall cabinets shall have 2 integral (dowel into end) mounting frames. Designs with simple spacer rails or rails without dowel pin engagement into ends not acceptable

F. Base Cabinets: Components shall be 3/4" members throughout. Base unit bottoms shall incorporate back groove end and up to 8 dowel pins per end joint (based on cabinet design). Base units shall have wide top and back frame feature. A frame (8-1/2" wide) in flat horizontal plan at cabinet front with minimum 3 dowels per end joint provides stable squaring of top area. A second frame 8-1/2" wide) in vertical plane behind back provides stable side-to-side rack resistance. Construction shall provide lateral and vertical stability. Open rear top to allows for easy wall mounting and ease of installation of mechanical services. Sub tops without horizontal and vertical plane ridged members not acceptable. Base cabinet ends shall be 3/4" thick with back groove and precision CNC (computer numerical control) drill pattern for accurate location of fixed members, hardware, and shelf supports.
G. Toe Kicks: Bases and tall cabinets shall be integral base design. Construction of end panels, cabinet bottoms and horizontal toe kick members shall be integrally joined together for greater structural strength. Design shall facilitate load transfer from upper loaded areas directly through cabinet ends to floor, reducing lower joint stress.

H. Cabinet Backs: Shall be integrated system of 1/4" prefinished MDF (medium density fiberboard) back captured in side and horizontal grooves. Unit back shall be further integrated with attachment to 3/4" doweled-in mounting frames. Fixed backs shall be mechanically fastened into grooves and sealed with hot melt adhesive. Removable backs at sink cabinets, shall be set in groove and attached to back frame with screws.

I. Adjustable Shelves: Shelving shall be 3/4" thick. Shelving shall have end 4-point support for spans 27" or less. Spans above 27" shall have 5-point support with backs drilled to receive additional mid-span shelf support, reducing deflection under heavier loads. Shelving above 36" in length shall be 1" thick. [Specialty shelving requiring retaining ledge shall have powder coated metal angle.

J. Drawers: Shall be finished in TF (thermo-fused) laminate surface as indicated above. 4 sided full box design with separate attached front shall be provided. Drawer members shall be 3/4" thick with dowel pin construction at all 4 corners. Drawer bottoms shall be 1/4" MDF core trapped in groove 4 edges as well as mechanically fastened. Drawer components shall be edged with (0.020") flat edge extrusion. Automated hot melt adhesive application and trimming. Drawers utilizing 1/2" members or with overlay applied bottoms, non-captured groove, or staple butt or lap construction not acceptable.
2.8 COUNTERTOPS

A. Epoxy Resin Tops: High performance laboratory tops available in basic Black and 5 optional colors. Epoxy resin tops shall meet and/or exceed industry standards. Tops shall be factory fabricated and drilled, with exposed cutouts and edges dressed with factory finish. Leading edges shall have 3mm corner radius and include bottom drip grooving. Epoxy sinks shall be under-mount type, molded in one solid piece, coved inside corners, dished bottom to outlet, and color matched to tops. Epoxy tops shall be installed with epoxy sealant at joints and sink applications.

1. Design Required:
   a) ES00BL: 3/4" Black epoxy.
      1. Standard: 52U15C; under-mount, epoxy, center outlet, black; 16" long x 12" wide x 8" sink depth; 52S03R outlet, 52PSS2 stopper.
      2. Accessible: 52U05C; under-mount, epoxy, center outlet, black; 14" long x 10" wide x 8" sink depth; 52S03R outlet, 52PSS2 stopper.

2.9 SERVICE FIXTURES

A. Single Service and Mixing Faucets - General: Cast brass faucet bodies with chrome plated finish. Faucets provided with brass four-arm handles or 4" wrist blade handles with color-coded index discs. Valves shall be self-contained renewable type with replaceable stainless steel seats. Faucets shall be factory assembled and tested.

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</tr>
<tr>
<td>Hot Water</td>
<td>Red</td>
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B. Mixing Faucet: Vandal resistant. Deck mounted for hot and cold water. 6" rigid gooseneck. Integral vacuum breaker. 1/2" IPS with 2 - 1/2" OC slipjoints. 3/8" NPS female outlet with removable aerator.

2. Accessible Mixing Faucet w/ 4" Wrist Blades: 5224V-6WB.
C. Sink Outlets:
   1. Epoxy Sinks: Polypropylene sink outlet with integral cross bars, locknuts, and washers. Outlet fitted with removable polypropylene stopper with 1/4" diameter hole for chain; chain not provided. 1-1/2" NPS threads.

D. Emergency Eye/Face Spray: Soft-flow dual perforated ABS plastic sprayheads with protective covers; chrome-plated brass valve with extended handle stays open once handle is squeezed; 8" yellow reinforced thermoplastic hose with 3/8" NPT male threads.
   1. Products:
      b) Vacuum Breaker: Series 9 Dual-Check Vacuum Breaker.
      c) Mixing Valve: Navigator EFX8 Emergency Thermostatic Mixing Valve.

3. PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify adequacy of backing and support framing.

C. Verify location and sizes of utility rough-in associated with Work of this section.

3.2 INSTALLATION

A. Set and secure casework in place; rigid, plumb, and level.

B. Use fixture attachments in concealed locations for wall mounted components.

C. Use concealed joint fasteners to align and secure adjoining cabinet units and countertops.
D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.

E. Secure cabinets and sub-bases to flooring using appropriate angles and anchorages.

3.3 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Adjust moving or operating parts to function smoothly and correctly.

3.4 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Clean casework, countertops, shelves, hardware, fittings, and fixtures.

3.5 PROTECTION OF INSTALLED WORK

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed work.

B. Do not permit finished casework to be exposed to continued construction activity.
3.6 SCHEDULE

A. Plastic-Laminate-Clad Laboratory Casework:
   1. Classroom 138, Classroom 217: Refer to Drawings for casework locations and model numbers.
   2. Color Selections and Applications:
      a) Exposed: Cabinet finish edges, fronts, modesty panels, and finish back HPL shall be selected from Wilsonart Design Group I patterns (standard price category); 2 colors for Project, as selected.
      b) Edging: Selected from manufacturer’s standard; 2 colors for Project, as selected.

END OF SECTION
SECTION 12 35 50.16

PLASTIC-LAMINATE-CLAD STANDARD CASEWORK

1. PART 1  GENERAL

1.1  SUMMARY

A.  Section Includes:
   1. Plastic laminate standard casework.
   2. Countertops.

B.  Related Requirements:
   1. Section06 10 53 - Miscellaneous Rough Carpentry: Grounds and support framing.
   2. Section 09 65 00 - Resilient Flooring: Vinyl cove base for casework.
   3. Division 22 - Plumbing: Sinks, sink fittings, and faucets.
   4. Division 26 - Electrical: J-boxes, electrical outlets, and faceplates.
   5. Division 27 - Communications: J-boxes, data outlets, and faceplates.

1.2  REFERENCE STANDARDS

A.  American National Standards Institute:
   1. ANSI A208.1 - Mat Formed Wood Particleboard.

B.  ASTM International:

C.  National Electrical Manufacturers Association:
   1. NEMA LD3 - High Pressure Decorative Laminates.

1.3  SYSTEM DESCRIPTION

A.  Plastic-Laminate-Clad Standard Casework: Dimensions, configurations, functions, and hardware shall conform to those of reference manufacturer’s product numbers indicated on Drawings. In addition, provide non-standard casework as indicated by dimensions, configurations, function, and details indicated on Drawings.
1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate casework locations, large scale plans, elevations, cross sections, rough-in and anchor placement dimensions and tolerances, and hardware locations.

C. Product Data:
   1. Submit data on high-pressure plastic laminate, pressure fused laminate, and edging.
   2. Submit data on hardware and accessories.

D. Samples:
   1. Submit one sample, 4 x 6 inches in size illustrating cabinet exterior and interior finishes.
   2. Submit one sample, 4 x 6 inches in size counter top finishes.
   3. Submit two set of samples for Architect/Engineer's selection of plastic laminate and edging colors.
   4. Submit one sample pull, hinge, and lock illustrating hardware finish and style.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout submittals.

B. Product Record Documents: Record actual locations of concealed utility connections. Record actual locations of installed locks and their master key codes.

C. Operation and Maintenance Data: Submit description of equipment operation, adjusting, and testing required. Identify system maintenance requirements, servicing cycles, lubrication types required, and spare parts sources.

D. Keys: Deliver with identifying tabs to Owner.

E. Warranty: Submit manufacturers warranty and ensure forms have been completed in Owner’s name and registered with manufacturer.
1.6 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing Products specified in this Section.
B. Installer: Company specializing in performing Work of this Section.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
B. Accept casework on site. Inspect on arrival for damage.
C. Coordinate size of access and route to place of installation.

1.8 AMBIENT CONDITIONS
A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.
B. Maintain storage space relative humidity within ranges recommended by manufacturer.
C. Subsequent Conditions: Maintain same temperature and humidity conditions in building spaces as will occur after occupancy during and after installation of Work of this Section.

1.9 COORDINATION
A. Section 01 30 00 - Administrative Requirements: Coordination and Project conditions.
B. Coordinate Work with location and placement of utilities.
C. Sequence installation to accommodate utility connections.
D. Coordinate Owner’s keying requirements during course of Work.

1.10 EXISTING CONDITIONS
A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.
1.11 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout submittals.

B. Provide 3 year manufacturer warranty for casework.

2. PART 2 PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD STANDARD CASEWORK

A. Manufacturers - Manufactured Plastic Laminate Casework:
   2. Other Acceptable Manufacturers:
      a) Case Systems.
      b) TMI Systems Design Corporation.
   3. Substitutions: Section 01 60 00 - Product Requirements.

2.2 SURFACE MATERIALS

A. Cabinets:
   1. Exposed finish ends, fronts, modesty panels, and finished backs shall be faced with PF-28 (0.028") High Pressure Laminate (HPL), tested under NEMA LD-3. Decorate laminate shall be thermoset to core using catalyzed Polyvinyl Acetate (PVA) glue with minimum 80 pounds per square inch (PSI) pressure and average 180 degrees F. Lower pressure and cold curing glue not acceptable.
   2. Panels with PF-28 surfaces shall have Cabinet Liner Surface (CLS) (0.020") interior cabinet liner.

B. Interiors:
   1. Semi-exposed surfaces shall be manufacturer’s standard TF (thermo-fused) laminate two sides. Laminate shall be homogenous, thermofused to core face, resulting in panel structure warranted against delamination. Manufacturer’s standard TF laminate shall be tested under NEMA LD 3 vertical grade GP-28 standards. TF lamination shall use high pressure 350-400 PSI with thermosetting temperatures of 380-400 degrees F under precision controlled press cycle with textured surface finishes.
C. Drawers: Shall be finished entirely in TF.

D. Semi-Exposed Backs: Shall be prefinished MDF (medium density fiberboard).

2.3 CORE MATERIALS

A. Particleboard: High performance industrial grade M2 core; 45# - 48# density 3-ply type formation conforming to ANSI A208.1 and ASTM D1037 standards.

B. Medium Density Fiberboard (MDF): 48# density core conforming to ANSI A208.1 MD-130 standards.

2.4 EDGING

A. Cabinet Edges: All vertical and horizontal leading cabinet edges, adjustable shelves and interior vertical and horizontal components shall be edged with (0.020") flat edge PVC (polyvinyl chloride) extrusion. Automated hot melt adhesive application and trimming.

B. Door and Drawer Fronts: Edges shall have 3mm radius PVC extrusion banding. Automated hot melt adhesive application and trimming.

C. Drawer Components: 3/4" sides shall be edged with (0.020") flat edge PVC extrusion. Automated hot melt adhesive application and trimming.

2.5 SELECTIONS AND APPLICATIONS

A. Cabinets: HPL for exposed finished ends, fronts, modesty panels and finished backs shall be selected from manufacturers standard offering.

B. Interior: Semi-exposed surfaces shall be manufacturers standard White solid color.

C. Drawers: Drawer box shall be manufacturers standard White solid color.

D. Edging: Edgebanding shall be selected from manufacturer’s standard offering and commercially available stock patterns.
E. Laminate Countertops: Shall be selected from manufacturer’s standard offering.

F. Countertop Supports: Shall be powder coated Black.

2.6 HARDWARE

A. 5-Knuckle Overlay Hinges: Heavy duty 5-knuckle 270 degree pivot reveal overlay style. Hinges shall have interlaying leaves 270 degree swing construction of 0.090" thickness steel. Hinges shall be Grade 1 with hospital ground tips and non-removeable pin. Doors 48" or less shall have 2 hinges per door. Doors exceeding 48" shall have 3 hinges per door. Hinges shall have vertical adjustment and shall be mounted with 2 - 5mm thread-in screw bolts plus 2 additional #8 screws in cabinet leaf. Door leaf shall have 2 - 5mm thread-in bolts plus 3 - #8 screws. Total 9 fasteners per hinges. Mountings without 5mm thread-in screw bolt fasteners not acceptable.

1. Product: 5K Overlay Hinge with Grey Chrome powder coated finish.

B. Door Catches: Heavy duty spring loaded, large diameter (16mm) roller catches mounted at door bottom. Catch strike plate shall be injection molded with integral molded engagement ridge and wide face bumper door stop. Doors exceeding 48" shall have catches at both top and bottom.

C. Pulls: Shall be easy grip 5" U-shaped, easy grip profile 8mm diameter formed wire, 5" center-to-center; one each door and drawer.


D. Drawer Slides:

1. Standard Drawer Slides: Extension slides shall be bottom and side mounted epoxy coated steel slides. Lateral stability shall be achieved through formed captive slide profile, and slides shall glide on nylon rollers. Slides shall have both in and out drawer stop with self close feature. Slides shall carry 100 pound dynamic load rating.

E. Hanger Bars: Heavy chrome plated oval tubing mounted in adjustable end wall sockets.
F. Shelf Supports: Adjustable shelf supports shall be injection molded clear polycarbonate. Supports shall incorporate integral molded lock tabs to retain shelf from tipping or inadvertent lift out. Supports shall have 5mm diameter double pin engagement into precision bored cabinet vertical hole patterns. Adjustment shall be 1-1/4" spacings. Supports shall have compression ridge effecting force against shelf edge to maintain positive pin engagement. Supports shall have molded-in screw attachment feature. Static test load shall exceed 200# per clip. Shelf spans greater than 27" shall have 5-point support with backs drilled to receive mid-span shelf support, to reduce deflection. Shelf spans 27" or less shall have end 4-point support.

G. Bins: High impact polystyrene or polyethylene formed bins shall be provided where indicated. Bins shall be supported on welded wire powder coated rack system. System shall include side suspension rack uprights with top and bottom horizontal guideways to avoid inadvertent tip out.

H. Locks: High security 6-tumbler lock system shall be provided for all tall cabinet doors. Locks shall have diecast body with dead bolt engagement tang; cylinder locks with attached rotating cams not acceptable. Locks shall have removable and interchangeable 6-tumbler core for easy field and Owner re-keying options. Locks shall be master keyed and available key-alike or key-different with 250 standard key changes and possibility of up to 2000 total changes where required; key tall storage and wardrobe door locks differently, masterkey locks in each room, masterkey each room differently. Each lock shall be provided with two double bit keys and face of lock stamped with key number; in addition, provide 2 blue color coded masterkeys each room, and 2 red color coded core keys for in-field re-keying.
1. Product: 6-tumbler dead bolt lock.

2.7 COMPONENT DETAILS AND CONSTRUCTION

A. Fronts:
1. Door and Drawer Fronts: Shall be 3/4” thick and shall have facers as indicated above. Edges shall have 3mm radius edge extrusions matching face. Automated hot melt adhesive application and trimming.

B. Mounting Frames: Shall be 3/4” thick structural members.
C. Wall Cabinets: Components shall be 3/4" thick members throughout. Wall cabinet tops and bottoms shall include back groove and minimum 4 dowel pins per joint for insertion into cabinet ends. Wall cabinet ends shall be 3/4" thick with back groove and precision CNC (computer numerical control) drill pattern location of fixed members, hardware, and shelf supports. Wall cabinets shall have 2 integral (dowel into end) mounting frames. Designs with simple spacer rails or rails without dowel pin engagement into ends not acceptable.

D. Tall Cabinets: Components shall be 3/4" thick members throughout. Tall cabinet tops and bottoms shall include back groove and minimum 8 total dowels per end joint (based on cabinet depth). Tall cabinet ends shall be 3/4" thick with back groove and precision CNC (computer numerical control) drill pattern for accurate location of fixed members, hardware, and shelf supports. Tall cabinets shall have 3 integral (dowel into end) mounting frames. Designs with simple spacer rails or rails without dowel pin engagement into ends not acceptable.

E. Base Cabinets: Components shall be 3/4" members throughout. Base unit bottoms shall incorporate back groove end and up to 8 dowel pins per end joint (based on cabinet design). Base units shall have wide subtop rail and back frame feature. Subtop rail (8" wide) in flat horizontal plane at cabinet front shall provide stable squaring of top area. A mounting frame (8" wide) in vertical plane behind back shall provide stable side-to-side rack resistance. Construction shall provide lateral and vertical stability. Secondary mounting frame shall be doweled into ends at lower rear. Open rear top area to provide easy wall mounting and ease of installation of mechanical services; subtops without horizontal and vertical plane ridged frame members not acceptable. Base cabinet ends shall be 3/4" thick and back groove and precision CNC drill pattern for accurate location of fixed members, hardware and shelf supports.

F. Toe Kicks: Bases and tall cabinets shall be integral base design. Construction of end panels, cabinet bottoms and horizontal toe kick members shall be integrally joined together for greater structural strength. Design shall facilitate load transfer from upper loaded areas directly through cabinet ends to floor, reducing lower joint stress; separate attached bases not acceptable.
G. Backs:
1. Cabinet Back System: Shall be composed of 1/4” prefinished MDF back captured in side and horizontal grooves. Unit back shall be further integrated with attachment to 3/4” doweled-in mounting frames. Fixed backs shall be mechanically fastened into grooves and sealed with hot melt adhesive. Combination of back with 3/4” frame shall create 1” integrated structural mounting system.
2. Removable Backs: Shall be in sink cabinets, set in groove and attached to back frame with screws.

H. Adjustable Shelves: Shelves 36” or less in length shall be 3/4” thick. Shelves over 36” in length shall be 1” thick.

I. Drawers: 4 sided full box design with separate attached front shall be provided. Drawer members shall be 3/4” thick with dowel pin construction at all 4 corners. Drawer bottoms shall be 1/4” MDF trapped in groove 4 edges as well as mechanically fastened. Entire box shall be TF laminated. Drawers with overlay applied bottoms, non-captured groove or with staple butt or lap joint construction not acceptable.

2.8 COUNTERTOPS

A. Laminate Countertops: Shall be 1-1/16” thick with solid core structures and laminated with backer sheet. Countertops shall be HPL, thermoset to core using catalyzed PVA glue with minimum average pressure of 80 psi and average 180 degree F temperature. Decorative laminate shall meet NEMA LD3 Horizontal Grade Standard (HGS) standards. Laminate patterns shall be chosen from manufacturers standard offering.
1. Design Required:
   a) LS00C: 90 degree postform seamless front edge countertops with matching applied 90 degree postform edge backsplash and applied self edge endsplash.
3. PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify adequacy of backing and support framing.

C. Verify location and sizes of utility rough-in associated with Work of this Section.

3.2 INSTALLATION

A. Set and secure casework in place; rigid, plumb, and level.

B. Use fixture attachments in concealed locations for wall mounted components.

C. Use concealed joint fasteners to align and secure adjoining cabinet units and countertops.

D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.

E. Secure cabinets and sub-bases to flooring using appropriate angles and anchorages.

3.3 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Adjust moving parts to function smoothly and correctly.

3.4 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Clean casework, countertops, shelves, hardware, and accessories.
3.5 PROTECTION OF INSTALLED WORK

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed work.

B. Do not permit finished casework to be exposed to continued construction activity.

3.6 SCHEDULE

A. Plastic-Laminate-Clad Standard Casework: Refer to Drawings for casework locations and model numbers.

1. Color Selections and Applications:
   a) Exposed: Cabinet finish edges, fronts, modesty panels, and finish back HPL shall be selected from Wilsonart Design Group I patterns (standard price category); 4 colors for Project, as selected.
   b) Laminate Countertops: HPL shall be selected from Wilsonart Design Group I patterns (standard price category); 4 colors for Project, as selected.
   c) Edging: Selected from manufacturer’s standard; 4 colors for Project, as selected.

END OF SECTION
1. PART 1  GENERAL

1.1  SUMMARY

A.  Section Includes:
   1. Plastic laminate standard casework.
   2. Countertops.

B.  Related Requirements:
   1. Section 06 10 53 - Miscellaneous Rough Carpentry: Grounds and support framing.
   2. Section 09 65 00 - Resilient Flooring: Vinyl cove base for casework.

1.2  REFERENCE STANDARDS

A.  American National Standards Institute:
   1. ANSI A208.1 - Mat Formed Wood Particleboard.

B.  American National Standards Institute/Builders Hardware Manufacturers Association:
   1. ANSI/BHMA A156.9 - Cabinet Hardware.

C.  ASTM International:

D.  National Electrical Manufacturers Association:
   1. NEMA LD3 - High Pressure Decorative Laminates.

1.3  SYSTEM DESCRIPTION

A.  Plastic-Laminate-Clad Band Casework: Dimensions, configurations, functions, and hardware shall conform to those of reference manufacturer's product numbers indicated on Drawings. In addition, provide non-standard casework as indicated by dimensions, configurations, function, and details indicated on Drawings.
1.4 **SUBMITTALS**

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate casework locations, large scale plans, elevations, cross sections, rough-in and anchor placement dimensions and tolerances, and hardware.

C. Product Data:
   1. Submit data on high-pressure plastic laminate, pressure fused laminate, grille doors, and edging.
   2. Submit data on hardware and accessories.

D. Samples:
   1. Submit one sample, 4 x 6 inches in size illustrating cabinet exterior and interior finishes.
   2. Submit two set of samples for Architect/Engineer's selection of plastic laminate and edging colors.

1.5 **CLOSEOUT SUBMITTALS**

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout submittals.

B. Warranty: Submit manufacturers warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 **QUALIFICATIONS**

A. Manufacturer: Company specializing in manufacturing Products specified in this Section.

B. Installer: Company specializing in performing Work of this Section.

1.7 **DELIVERY, STORAGE, AND HANDLING**

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Accept casework on site. Inspect on arrival for damage.

C. Coordinate size of access and route to place of installation.
1.8 AMBIENT CONDITIONS

A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

B. Maintain storage space relative humidity within ranges recommended by manufacturer.

C. Subsequent Conditions: Maintain same temperature and humidity conditions in building spaces as will occur after occupancy during and after installation of Work of this Section.

1.9 EXISTING CONDITIONS

A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout submittals.

B. Provide 3 year manufacturer warranty for casework.

2. PART 2 PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD BAND CASEWORK

A. Manufacturers - Manufactured Plastic Laminate Casework:
   2. Other Acceptable Manufacturers:
      a) Case Systems.
      b) TMI Systems Design Corporation.
   3. Substitutions: Section 01 60 00 - Product Requirements.
2.2 SURFACE MATERIALS

A. Cabinets:
   1. Exposed finish ends, fronts, and finished backs shall be faced with PF-28 (0.028") High Pressure Laminate (HPL), tested under NEMA LD-3. Decorate laminate shall be thermoset to core using catalyzed Polyvinyl Acetate (PVA) glue with minimum 80 pounds per square inch (PSI) pressure and average 180 degrees F. Lower pressure and cold curing glue not acceptable.
   2. Panels with exterior PF-28 surfaces shall have Cabinet Liner Surface (CLS) (0.020") interior cabinet liner.

B. Interiors:
   1. Semi-exposed surfaces shall be manufacturer’s standard TF (thermo-fused) laminate two sides. Laminate shall be homogenous, thermofused to core face, resulting in panel structure warranted against delamination. Manufacturer’s standard TF laminate shall be tested under NEMA LD 3 vertical grade GP-28 standards. TF lamination shall use high pressure 350-400 PSI with thermosetting temperatures of 380-400 degrees F under precision controlled press cycle with textured surface finishes.

C. Backs: Shall shall have Pearl White finish. be prefinished

2.3 CORE MATERIALS

A. Particleboard: High performance industrial grade core; 45# - 48# density 3-ply type formation conforming to ANSI A208.1 and ASTM D1037 standards.

B. Medium Density Fiberboard (MDF): 48# density core conforming to ANSI A208.1 MD-130 standards.

2.4 EDGING

A. Cabinet Edges: Cabinet sides, top, bottom, adjustable shelves and other interior components shall have 3mm radius edge high impact extrusion banding.
B. Instrument Cabinet Shelf Edges: Seamless one-piece wraparound front edge to shelf Scuff-Gard facing. Seamless nose shall have smooth rounded transition to shelf surfacing and flush machined to bottom shelf face.

2.5 SELECTIONS AND APPLICATIONS

A. Exposed: Cabinet finished ends, fronts, and finished back laminate shall be selected from manufacturers standard offering.

B. 3mm High Impact Edges: Shall be selected from manufacturers standard offering. Edging to be matching cabinet exterior face laminates or contrasting, as selected by Architect/Engineer.

C. Interior and Semi-Exposed Surfaces: Semi-exposed surfaces shall be manufacturers standard White solid color.

D. Backs: Shall have Pearl White finish.

E. Acousti-Grille Doors and Other Metal Components: Shall have Pearl White powder coated finishes.

2.6 HARDWARE

A. Hinges: For Acousti-Grille doors, provide inset type 5-knuckle design. Hinges shall have interlaying leaves, constructed of 0.090" thick steel allowing 180 degree pivot swing. Hinges shall be Grade 1 with hospital ground tips and non-removable pins. Grilles under 47" shall have 2 hinges per door; doors exceeding 47" shall have 4 hinges per door.

B. Acousti-Grille Doors: Shall be provided for individual compartments as indicated on Drawings. Wire Acousti-Grille doors shall have one-piece welded with full wrap 5/16" diameter steel frame. 5/16" cross framing reinforcement with 13/64" diameter vertical grille wires. Acousti-Grille doors shall have welded attached 5-knuckle hinges with cabinet mounting leaf using two 5mm thread-in screw bolts and two additional #8 screws each leaf.
C. Latching Mechanism: Shall be integral to Acousti-Grille doors. Doors shall have lock hasp, label and catch mechanism. Mechanism shall latch door shut automatically, without need of manual cross slides or finger activated locking. Latch shall release with simple grab action to release and open door. Mechanism shall integrate hasp design for padlock use. Padlock loop shall pass through hasp and latch providing secure locked door. Hasp design shall include large label holder area suitable for slide-in labels, adhesive backed and laminated engraved number systems.

D. Acousti-Grille doors and hasp locking mechanisms shall have color coordinated Pearl White powder coated finish.

E. Scuff-Gard: Instrument storage cabinet shelving shall have one-piece wraparound Scuff-Gard, Pearl White Scuff-Gard one-piece, high impact thermoform easy-clean surface with alternating tread design, allowing air circulation between stored material and shelf. Molded leading front edge shall encapsulate shelf edge with radius corners and be machined flush bottom design.

2.7 COMPONENT DETAILS AND CONSTRUCTION

A. Casework shall be inset front design. Vertical cabinet ends and compartment dividers shall extend to frontal plane of grille face. Hinge hardware shall be inset cabinet mounted and grille back mounted allowing 180 degree pivot opening.

B. Cabinet Components: Shall be 3/4" thick members throughout. Cabinet ends and compartment verticals shall have 3mm high impact extrusion edges. Ends shall have back groove, and vertical components 3/4" thick shall be precision NCN drilled for accurate location of adjoining members. Horizontal members shall be permanently affixed into dowel joined location for maximum security of individual storage compartments.

C. Tall Cabinets: Shall have 3 internal (dowel into end) mounting frames behind cabinet back. Additionally (dowel into end) toe kick frames shall be permanently mounted front and back. Entire unit to be case clamped and provided a rigid one-piece assembly.
D. Cabinet Backs: Shall be integrated system of 1/4" prefinished Pearl White MDF back captured in size and horizontal grooves. Unit back to be further integrated with attachment to 3/4" doweled-in mounting frames. Fixed backs shall be mechanically fastened into grooves and sealed with hot melt adhesive.

E. Instrument Storage Units: Units having both width and depth dimensions larger than 30" shall be shipped factory assembled. Fastening methods shall allow field disassembly, permitting passage through restrictive corridors and doorways.

3. PART 3  EXECUTION

3.1  EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify adequacy of backing and support framing.

C. Verify location and sizes of utility rough-in associated with Work of this Section.

3.2  INSTALLATION

A. Set and secure casework in place; rigid, plumb, and level.

B. Use fixture attachments in concealed locations for wall mounted components.

C. Use concealed joint fasteners to align and secure adjoining cabinet units and countertops.

D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.

E. Secure cabinets and sub-bases to flooring using appropriate angles and anchorages.
3.3 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Adjust moving parts to function smoothly and correctly.

3.4 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Clean casework, countertops, shelves, hardware, and accessories.

3.5 PROTECTION OF INSTALLED WORK

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed work.

B. Do not permit finished casework to be exposed to continued construction activity.

3.6 SCHEDULE

A. Plastic-Laminate-Clad Standard Casework:
   1. Refer to Drawings for casework locations and model numbers:
      a) 5120 Band and Music Series Casework:
         1. Exposed: Cabinet finish edges, fronts, modesty panels, and finish back HPL shall be selected from Wilsonart Design Group I patterns (standard price category); 1 color for Project, as selected.
         2. Edging: Selected from manufacturer’s standard; 1 color for Project, as selected.

END OF SECTION
SECTION 21 05 17
SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Sleeves.
   2. Grout.

PART 2 PRODUCTS

2.01 SLEEVES
A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron
   pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded
   steel collar; zinc coated.
C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc
   coated, with plain ends.
E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with
   welded longitudinal joint.
F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with
   nailing flange for attaching to wooden forms.
G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.02 GROUT
A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, 
   hydraulic-cement grout.
B. Characteristics: Nonshrink; recommended for interior and exterior applications.
C. Design Mix: 5000-psi, 28-day compressive strength.
D. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.01 SLEEVE INSTALLATION
A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to
   provide 1-inch annular clear space between piping and concrete slabs and walls.
   1. Sleeves are not required for core-drilled holes.
C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and
   walls are constructed.
   1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP
      sleeves.
   2. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other
         wet areas 2 inches above finished floor level.
   3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal
      system.
D. Install sleeves for pipes passing through interior partitions.
1. Cut sleeves to length for mounting flush with both surfaces.
2. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 07 92 00 "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 07 84 13 "Penetration Firestopping."

3.02 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:
   1. Interior Partitions:
      a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves. PVC-pipe sleeves are acceptable if allowed by local AHJ.
SECTION 21 05 18

ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Escutcheons.

PART 2 PRODUCTS

2.01 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
D. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
   1. Escutcheons for New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
      e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
      f. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
      g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.

3.02 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons using new materials.

END OF SECTION 21 05 18
SECTION 21 13 13
WET-PIPE SPRINKLER SYSTEMS

PART 1 GENERAL

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

1.02 SUMMARY
   A. Section Includes:
      1. Pipes, fittings, and specialties.
      2. Fire-protection valves.
      5. Pressure gages.

1.03 DEFINITIONS
   A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at
      working pressure of 175 psig maximum.

1.04 SYSTEM DESCRIPTIONS
   A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and
      that is connected to water supply through alarm valve. Water discharges immediately from
      sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys
      frangible device. Hose connections are included if indicated.
   B. Extend existing sprinkler system to new additions and renovated areas.

1.05 PERFORMANCE REQUIREMENTS
   A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
   B. Sprinkler system design shall be approved by authorities having jurisdiction.
      1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses
         through water-service piping, valves, and backflow preventers.
      2. Sprinkler Occupancy Hazard Classifications:
         a. Building Service Areas: Ordinary Hazard, Group 1.
         b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
         c. General Storage Areas: Ordinary Hazard, Group 1.
         d. Laundries: Ordinary Hazard, Group 1.
         e. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
         f. Office and Public Areas: Light Hazard.
         g. Minimum Density for Automatic-Sprinkler Piping Design:
            1) Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
            2) Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
            3) Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
         h. Maximum Protection Area per Sprinkler: Per UL listing.
            1) Office Spaces: 120 sq. ft..
            2) Storage Areas: 130 sq. ft..
            3) Mechanical Equipment Rooms: 130 sq. ft..
            4) Electrical Equipment Rooms: 130 sq. ft..
            5) Other Areas: According to NFPA 13 recommendations unless otherwise
               indicated.
         i. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless
            otherwise indicated:
            1) Light-Hazard Occupancies: 100 gpm for 30 minutes.
            2) Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.
1.06 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.

C. Qualification Data: For qualified Installer.

D. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

E. Fire-hydrant flow test report.

F. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

G. Field quality-control reports.

H. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.07 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
   1. NFPA 13, "Installation of Sprinkler Systems."
   2. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
   3. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

1.08 PROJECT CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
   1. Notify Owner no fewer than days in advance of proposed interruption of sprinkler service.
   2. Do not proceed with interruption of sprinkler service without Owner's written permission.

1.09 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.10 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. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.
PART 2 PRODUCTS

2.01 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.02 STEEL PIPE AND FITTINGS

A. Standard Weight, Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
B. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.
D. Uncoated, Steel Couplings: ASTM A 865, threaded.
F. Malleable- or Ductile-Iron Unions: UL 860.
H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
J. Grooved-Joint, Steel-Pipe Appurtenances:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil International, Inc.
      b. Corcoran Piping System Co.
      c. National Fittings, Inc.
      d. Shurjoint Piping Products.
      e. Tyco Fire & Building Products LP.
      f. Victaulic Company.
   2. Pressure Rating: 175 psig minimum.
   4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
K. Steel Pressure-Seal Fittings: UL 213, FM-approved, 175-psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers’ pressure-seal tools.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Victaulic Company.

2.03 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
   1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
   2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
2.04 LISTED FIRE-PROTECTION VALVES

A. General Requirements:
   1. Valves shall be UL listed or FM approved.

B. Ball Valves:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Anvil International, Inc.
      b. Victaulic Company.
   2. Standard: UL 1091 except with ball instead of disc.
   3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
   4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
   5. Valves NPS 3: Ductile-iron body with grooved ends.

C. Iron Butterfly Valves:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Anvil International, Inc.
      b. Fivalco Inc.
      c. Global Safety Products, Inc.
      d. Kennedy Valve; a division of McWane, Inc.
      e. Milwaukee Valve Company.
      f. NIBCO INC.
      g. Pratt, Henry Company.
      h. Shurjoint Piping Products.
      i. Tyco Fire & Building Products LP.
      j. Victaulic Company.
   2. Standard: UL 1091.
   4. Body Material: Cast or ductile iron.
   5. End Connections: Grooved.

D. Check Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AFAC Inc.
      b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
      c. Anvil International, Inc.
      d. Clow Valve Company; a division of McWane, Inc.
      e. Crane Co.; Crane Valve Group; Crane Valves.
      f. Crane Co.; Crane Valve Group; Jenkins Valves.
      g. Crane Co.; Crane Valve Group; Stockham Division.
      h. Fire-End & Croker Corporation.
      i. Fire Protection Products, Inc.
      j. Fivalco Inc.
      k. Globe Fire Sprinkler Corporation.
      l. Groeniger & Company.
      m. Kennedy Valve; a division of McWane, Inc.
      n. Matco-Norca.
      o. Metraflex, Inc.
      p. Milwaukee Valve Company.
      q. Mueller Co.; Water Products Division.
2. Iron OS&Y Gate Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
      b. American Valve, Inc.
      c. Clow Valve Company; a division of McWane, Inc.
      d. Crane Co.; Crane Valve Group; Crane Valves.
      e. Crane Co.; Crane Valve Group; Jenkins Valves.
      f. Crane Co.; Crane Valve Group; Stockham Division.
      g. Hammond Valve.
      h. Milwaukee Valve Company.
      i. Mueller Co.; Water Products Division.
      j. NIBCO INC.
      k. Shurjoint Piping Products.
      l. Tyco Fire & Building Products LP.
      m. United Brass Works, Inc.
      n. Watts Water Technologies, Inc.
   4. Body Material: Cast or ductile iron.
   5. End Connections: Flanged or grooved.

2.05 TRIM AND DRAIN VALVES

A. General Requirements:
   2. Pressure Rating: 175 psig minimum.

B. Angle Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Fire Protection Products, Inc.
      b. United Brass Works, Inc.

C. Ball Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Affiliated Distributors.
      b. Anvil International, Inc.
      c. Barnett.
      d. Conbraco Industries, Inc.; Apollo Valves.
D. Globe Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Fire Protection Products, Inc.
      b. United Brass Works, Inc.

E. Plug Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Southern Manufacturing Group.

2.06 SPECIALTY VALVES

A. General Requirements:
   2. Pressure Rating:
      a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
   3. Body Material: Cast or ductile iron.
   4. Size: Same as connected piping.
   5. End Connections: Flanged or grooved.

B. Automatic (Ball Drip) Drain Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AFAC Inc.
      b. Reliable Automatic Sprinkler Co., Inc.
      c. Tyco Fire & Building Products LP.
   4. Type: Automatic draining, ball check.

2.07 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil International, Inc.
b. National Fittings, Inc.
c. Shurjoint Piping Products.
d. Tyco Fire & Building Products LP.
e. Victaulic Company.

5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AGF Manufacturing Inc.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.

4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

C. Branch Line Testers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Fire-End & Croker Corporation.
   c. Potter Roemer.

2. Standard: UL 199.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AGF Manufacturing Inc.
   b. Triple R Specialty.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.
   e. Viking Corporation.

4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.
2.08 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AFAC Inc.
   3. Reliable Automatic Sprinkler Co., Inc.
   4. Tyco Fire & Building Products LP.
   5. Venus Fire Protection Ltd.

B. General Requirements:

C. Automatic Sprinklers with Heat-Responsive Element:
   2. Nonresidential Applications: UL 199.
   3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:
   1. Chrome plated.
   2. Bronze.
   3. Painted.

E. Special Coatings:
   1. Wax.
   2. Lead.
   3. Corrosion-resistant paint.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
   1. Sidewall Mounting: Chrome-plated steel, one piece, flat.

G. Sprinkler Guards:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Reliable Automatic Sprinkler Co., Inc.
      b. Tyco Fire & Building Products LP.
      c. Victaulic Company.
      d. Viking Corporation.
   2. Standard: UL 199.
   3. Type: Wire cage with fastening device for attaching to sprinkler.

2.09 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Flow Indicators:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ADT Security Services, Inc.
      b. McDonnell & Miller; ITT Industries.
      c. Potter Electric Signal Company.
      d. System Sensor, a Honeywell company.
      e. Viking Corporation.
f. Watts Industries (Canada) Inc.
4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
7. Design Installation: Horizontal or vertical.

C. Pressure Switches:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AFAC Inc.
   b. Barksdale, Inc.
   c. Detroit Switch, Inc.
   d. Potter Electric Signal Company.
   e. System Sensor; a Honeywell company.
   f. Tyco Fire & Building Products LP.
   g. United Electric Controls Co.
   h. Viking Corporation.
3. Type: Electrically supervised water-flow switch with retard feature.
5. Design Operation: Rising pressure signals water flow.

D. Valve Supervisory Switches:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Fire-Lite Alarms, Inc.; a Honeywell company.
   b. Kennedy Valve; a division of McWane, Inc.
   c. Potter Electric Signal Company.
   d. System Sensor; a Honeywell company.
3. Type: Electrically supervised.
5. Design: Signals that controlled valve is in other than fully open position.

2.10 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AMETEK; U.S. Gauge Division.
2. Ashcroft, Inc.
4. WIKA Instrument Corporation.
B. Standard: UL 393.
C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
D. Pressure Gage Range: 0 to 250 psig minimum.
E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
F. Air System Piping Gage: Include "AIR" or "AIR/WATER" label on dial face.
PART 3 EXECUTION

3.01 PREPARATION
A. If required to finalize hydraulic calculations, perform fire-hydrant flow test according to NFPA 13 and NFPA 291.
B. Report test results promptly and in writing.

3.02 PIPING INSTALLATION
A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
   1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
D. Install unions adjacent to each valve in pipes NPS 2 and smaller.
E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
G. Install sprinkler piping with drains for complete system drainage.
H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
I. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
J. Install alarm devices in piping systems.
K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
L. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
M. Fill sprinkler system piping with water.
N. Install sleeve seals for piping penetrations of concrete walls and slabs.
O. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.03 JOINT CONSTRUCTION
A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
   1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

M. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

N. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.04 VALVE AND SPECIALTIES INSTALLATION
   A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

   B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

   C. Specialty Valves:
      1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.

3.05 SPRINKLER INSTALLATION
   A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

   B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

   C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.06 IDENTIFICATION
   A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

   B. Identify system components, wiring, cabling, and terminals.

3.07 FIELD QUALITY CONTROL
   A. Perform tests and inspections.

   B. Tests and Inspections:
1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Coordinate with fire-alarm tests. Operate as required.
5. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
D. Prepare test and inspection reports.

3.08 CLEANING
A. Clean dirt and debris from sprinklers.
B. Remove and replace sprinklers with paint other than factory finish.

3.09 PIPING SCHEDULE
A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
C. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:
   1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
   2. Standard-weight, black-steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.
   3. Standard-weight, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   4. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.
D. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 6, shall be one of the following:
   1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
   2. Standard-weight, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   3. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.
   4. Schedule 10, or hybrid black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   5. Schedule 10, or hybrid black-steel pipe with plain ends; welding fittings; and welded joints

3.10 SPRINKLER SCHEDULE
A. Use sprinkler types in subparagraphs below for the following applications:
   1. Rooms without Ceilings: Upright sprinklers.
   2. Rooms with Suspended Ceilings: Concealed sprinklers.
   4. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated.
B. Provide sprinkler types in subparagraphs below with finishes indicated.
   1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
   2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
   3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
4. Upright Pendant and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 21 13 13
SECTION 22 05 13
COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 GENERAL

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

1.02 SUMMARY
   A. Section includes general requirements for single-phase and polyphase, general-purpose,
      horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up
      to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment
      manufacturer for field installation.

1.03 COORDINATION
   A. Coordinate features of motors, installed units, and accessory devices to be compatible with the
      following:
      1. Motor controllers.
      2. Torque, speed, and horsepower requirements of the load.
      3. Ratings and characteristics of supply circuit and required control sequence.
      4. Ambient and environmental conditions of installation location.

PART 2 PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS
   A. Comply with NEMA MG 1 unless otherwise indicated.
   B. Comply with IEEE 841 for severe-duty motors.

2.02 MOTOR CHARACTERISTICS
   A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above
      sea level.
   B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected
      loads at designated speeds, at installed altitude and environment, with indicated operating
      sequence, and without exceeding nameplate ratings or considering service factor.

2.03 POLYPHASE MOTORS
   A. Description: NEMA MG 1, Design B, medium induction motor.
   B. Efficiency: Energy efficient, as defined in NEMA MG 1.
   C. Service Factor: 1.15.
   D. Multispeed Motors: Variable torque.
      1. For motors with 2:1 speed ratio, consequent pole, single winding.
      2. For motors with other than 2:1 speed ratio, separate winding for each speed.
   E. Multispeed Motors: Separate winding for each speed.
   F. Rotor: Random-wound, squirrel cage.
   G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
   H. Temperature Rise: Match insulation rating.
   I. Insulation: [Class F] <Insert class>.
   J. Code Letter Designation:
      1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
      2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
   K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame
      sizes smaller than 324T.
2.04 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS
   A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection
      requirements for controller with required motor leads. Provide terminals in motor terminal box,
      suited to control method.
   B. Motors Used with Variable Frequency Controllers: [Ratings, characteristics, and features
      coordinated with and approved by controller manufacturer.]
      1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and
         tested to resist transient spikes, high frequencies, and short time rise pulses produced by
         pulse-width modulated inverters.
      2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
      3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
      4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected
         motors.
   C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.05 SINGLE-PHASE MOTORS
   A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements
      of specific motor application:
      1. Permanent-split capacitor.
      2. Split phase.
      3. Capacitor start, inductor run.
      4. Capacitor start, capacitor run.
   B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
   C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust
      loading.
   D. Motors 1/20 HP and Smaller: Shaded-pole type.
   E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when
      winding temperature exceeds a safe value calibrated to temperature rating of motor insulation.
      Thermal-protection device shall automatically reset when motor temperature returns to normal
      range.

2.06 P3 EXECUTION (NOT APPLICABLE)

END OF SECTION 22 05 13
SECTION 22 05 17
SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

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

1.02 SUMMARY
A. Section Includes:
   1. Sleeves.
   2. Sleeve-seal systems.

PART 2 PRODUCTS
2.01 SLEEVES
A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron
   pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded
   steel collar; zinc coated.
C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc
   coated, with plain ends.
D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with
   welded longitudinal joint.
E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with
   nailing flange for attaching to wooden forms.

2.02 SLEEVE-SEAL SYSTEMS
A. Manufacturers: Subject to compliance with requirements, available manufacturers offering
   products that may be incorporated into the Work include, but are not limited to, the following:
   1. Advance Products & Systems, Inc.
   2. CALPICO, Inc.
   3. Metraflex Company (The).
   4. Pipeline Seal and Insulator, Inc.
   5. Proco Products, Inc.
B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space
   between piping and sleeve.
   1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include
      type and number required for pipe material and size of pipe.
   2. Pressure Plates: Carbon steel.
   3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length
      required to secure pressure plates to sealing elements.

2.03 GROUT
A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry,
   hydraulic-cement grout.
B. Characteristics: Nonshrink; recommended for interior and exterior applications.
C. Design Mix: 5000-psi, 28-day compressive strength.
D. Packaging: Premixed and factory packaged.

PART 3 EXECUTION
3.01 SLEEVE INSTALLATION
A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
   1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
   1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
   2. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
   3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 07 92 00 "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 07 84 13 "Penetration Firestopping."

3.02 SLEEVE-SEAL-SYSTEM INSTALLATION
A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.03 SLEEVE AND SLEEVE-SEAL SCHEDULE
A. Use sleeves and sleeve seals for the following piping-penetration applications:
   1. Exterior Concrete Walls above Grade:
      a. Piping Smaller Than NPS 6: Cast-iron wall sleeves.
      b. Piping NPS 6 and Larger: Cast-iron wall sleeves.
   2. Exterior Concrete Walls below Grade:
      a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.
         1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
      b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system.
         1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
   3. Concrete Slabs-on-Grade:
      a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.
         1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
      b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system.
         1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
   4. Concrete Slabs above Grade:
      b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.
5. Interior Partitions:

END OF SECTION 22 05 17
SECTION 22 05 18
ESCUTCHEONS FOR PLUMBING PIPING

PART 1 GENERAL

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

1.02 SUMMARY
   A. Section Includes:
      1. Escutcheons.

PART 2 PRODUCTS

2.01 ESCUTCHEONS
   A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
   B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and
      spring-clip fasteners.
   C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

PART 3 EXECUTION

3.01 INSTALLATION
   A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
   B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and
      with OD that completely covers opening.
      1. Escutcheons for New Piping:
         a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
         b. Insulated Piping: One-piece, stamped-steel type.
         c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
         d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
         e. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
         f. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.

3.02 FIELD QUALITY CONTROL
   A. Replace broken and damaged escutcheons using new material

END OF SECTION 22 05 18
SECTION 22 05 19
METERS AND GAGES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Liquid-in-glass thermometers.
   2. Thermowells.
   3. Dial-type pressure gages.
   4. Gage attachments.
   5. Test plugs.
   6. Test-plug kits.

1.03 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and
   maintenance manuals.

PART 2 PRODUCTS

2.01 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the
      following:
      a. Flo Fab Inc.
      b. Miljoco Corporation.
      d. Tel-Tru Manufacturing Company.
      e. Trerice, H. O. Co.
      f. Weiss Instruments, Inc.
      g. Winters Instruments - U.S.
   3. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
   4. Case Form: Adjustable angle unless otherwise indicated.
   5. Tube: Glass with magnifying lens and blue or red organic liquid.
   6. Tube Background: Nonreflective aluminum with permanently etched scale markings
      graduated in deg F.
   7. Window: Glass or plastic.
   8. Stem: Aluminum and of length to suit installation.
      a. Design for Thermowell Installation: Bare stem.
   10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of
       1.5 percent of scale range.

B. Plastic-Case, Industrial-Style, Liquid-in-Glass Thermometers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the
      following:
      a. Ernst Flow Industries.
      b. Marsh Bellofram.
      c. Miljoco Corporation.
      e. REOTEMP Instrument Corporation.
      f. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
2.02 THERMOWELLS

A. Thermowells:
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.03 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AMETEK, Inc.; U.S. Gauge.
   b. Ashcroft Inc.
   c. Ernst Flow Industries.
   d. Flo Fab Inc.
   e. Marsh Bellofram.
   f. Miljoco Corporation.
   g. Noshok.
   h. Palmer Wahl Instrumentation Group.
   i. REOTEMP Instrument Corporation.
   j. Tel-Tru Manufacturing Company.
   k. Trerice, H. O. Co.
   l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   m. Weiss Instruments, Inc.
   n. WIKA Instrument Corporation - USA.
   o. Winters Instruments - U.S.
3. Case: Liquid-filled type(s); metal; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
9. Window: Glass or plastic.
10. Ring: Metal.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

B. Direct-Mounted, Plastic-Case, Dial-Type Pressure Gages:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AMETEK, Inc.; U.S. Gauge.
   b. Ashcroft Inc.
   c. Flo Fab Inc.
   d. Marsh Bellofram.
   e. Miljoco Corporation.
   f. Noshok.
   g. Palmer Wahl Instrumentation Group.
   h. REOTEMP Instrument Corporation.
   i. Tel-Tru Manufacturing Company.
   j. Trerice, H. O. Co.
   k. Weiss Instruments, Inc.
   l. WIKA Instrument Corporation - USA.
   m. Winters Instruments - U.S.
   n. Standard: ASME B40.100.
   o. Case: Sealed type; plastic; 4-1/2-inch nominal diameter.
   p. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
   q. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
   r. Movement: Mechanical, with link to pressure element and connection to pointer.
   s. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
   t. Pointer: Dark-colored metal.
   u. Window: Glass or plastic.
   v. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.04 GAGE ATTACHMENTS
A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.05 TEST PLUGS
A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Flow Design, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Tetrece, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.
B. Description: Test-station fitting made for insertion into piping tee fitting.
C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.
E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.
2.06 TEST-PLUG KITS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Flow Design, Inc.
   4. Peterson Equipment Co., Inc.
   5. Sisco Manufacturing Company, Inc.
   6. Trise, H. O. Co.
   7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   8. Weiss Instruments, Inc.

B. Furnish one test-plug kit(s) containing one thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.

D. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch-diameter dial and probe. Dial range shall be at least 0 to 200 psig.

E. Carrying Case: Metal or plastic, with formed instrument padding.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

G. Install valve and snubber in piping for each pressure gage for fluids.

H. Install test plugs in piping tees.

I. Install thermometers in the following locations:
   1. Inlet and outlet of each water heater.

J. Install pressure gages in the following locations:
   1. Building water service entrance into building.
   2. Inlet and outlet of each pressure-reducing valve.
   3. Suction and discharge of each domestic water pump.

3.02 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.03 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

3.04 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each domestic water heater shall be the following:
   1. Industrial-style, liquid-in-glass type.
   2. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.
B. Thermometer stems shall be of length to match thermowell insertion length.

3.05 THERMOMETER SCALE-RANGE SCHEDULE
   A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F.
   B. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F.

3.06 PRESSURE-GAGE SCHEDULE
   A. Pressure gages at discharge of each water service into building shall be one of the following:
      1. Liquid-filled, direct-mounted, metal case.
      2. Sealed, direct-mounted, plastic case.
      3. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.
   B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be one of the following:
      1. Liquid-filled, direct-mounted, metal case.
      2. Sealed, direct-mounted, plastic case.
      3. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.
   C. Pressure gages at suction and discharge of each domestic water pump shall be one of the following:
      1. Liquid-filled, direct-mounted, metal case.
      2. Sealed, direct-mounted, plastic case.
      3. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.

3.07 PRESSURE-GAGE SCALE-RANGE SCHEDULE
   A. Scale Range for Water Service Piping: 0 to 100 psi.
   B. Scale Range for Domestic Water Piping: 0 to 100 psi.

END OF SECTION 22 05 19
PART 1 GENERAL

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

1.02 SUMMARY
   A. Section Includes:
      1. Brass ball valves.
      2. Bronze ball valves.
      4. Bronze lift check valves.
      5. Bronze swing check valves.
   B. Related Sections:
      1. Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
      2. Section 22 11 13 "Facility Water Distribution Piping" for valves applicable only to this piping.
      3. Section 22 11 16 "Domestic Water Piping" for valves applicable only to this piping.

1.03 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.

1.04 QUALITY ASSURANCE
   A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
   B. ASME Compliance:
      1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
      2. ASME B31.1 for power piping valves.
      3. ASME B31.9 for building services piping valves.
   C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.05 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

2.01 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:
   1. Handwheel: For valves other than quarter-turn types.
   2. Handlever: For quarter-turn valves NPS 6 and smaller.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
   1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve-End Connections:
   1. Flanged: With flanges according to ASME B16.1 for iron valves.
   2. Grooved: With grooves according to AWWA C606.
   4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.02 BRASS BALL VALVES

A. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Crane Co.; Crane Valve Group; Crane Valves.
      b. Crane Co.; Crane Valve Group; Jenkins Valves.
      c. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
      d. Hammond Valve.
      e. Jamesbury; a subsidiary of Metso Automation.
      f. Kitz Corporation.
      g. Marwin Valve; a division of Richards Industries.
      h. Milwaukee Valve Company.
      i. RuB Inc.
   2. Description:
      b. SWP Rating: 150 psig.
      c. CWP Rating: 600 psig.
      d. Body Design: Two piece.
      e. Body Material: Forged brass.
      f. Ends: Threaded.
      g. Seats: PTFE or TFE.
      h. Stem: Stainless steel.
      i. Ball: Stainless steel, vented.
      j. Port: Full.

B. Three-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Jomar International, LTD.
   b. Kitz Corporation.
   c. Marwin Valve; a division of Richards Industries.
   d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Three piece.
   e. Body Material: Forged brass.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Stainless steel.
   i. Ball: Stainless steel, vented.
   j. Port: Full.

2.03 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      b. Crane Co.; Crane Valve Group; Crane Valves.
      c. Hammond Valve.
      d. Lance Valves; a division of Advanced Thermal Systems, Inc.
      e. Milwaukee Valve Company.
      f. NIBCO INC.
      g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

   2. Description:
      b. SWP Rating: 150 psig.
      c. CWP Rating: 600 psig.
      d. Body Design: Two piece.
      e. Body Material: Bronze.
      f. Ends: Threaded.
      g. Seats: PTFE or TFE.
      h. Stem: Stainless steel.
      i. Ball: Stainless steel, vented.
      j. Port: Full.

B. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      b. Hammond Valve.
      c. Milwaukee Valve Company.
      d. NIBCO INC.

   2. Description:
      b. SWP Rating: 150 psig.
      c. CWP Rating: 600 psig.
d. Body Design: Three piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

2.04 BRONZE SWING CHECK VALVES
A. Class 125, Bronze Swing Check Valves with Bronze Disc:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering
      products that may be incorporated into the Work include, but are not limited to, the
      following:
         a. American Valve, Inc.
         b. Crane Co.; Crane Valve Group; Crane Valves.
         c. Crane Co.; Crane Valve Group; Jenkins Valves.
         d. Crane Co.; Crane Valve Group; Stockham Division.
         e. Hammond Valve.
         f. Kitz Corporation.
         g. Milwaukee Valve Company.
         h. NIBCO INC.
         i. Powell Valves.
         j. Red-White Valve Corporation.
         k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
         l. Zy-Tech Global Industries, Inc.
   2. Description:
      a. Standard: MSS SP-80, Type 3.
      b. CWP Rating: 200 psig.
      c. Body Design: Horizontal flow.
      e. Ends: Threaded.
      f. Disc: Bronze.

2.05 IRON SWING CHECK VALVES
A. Class 125, Iron Swing Check Valves with Metal Seats:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering
      products that may be incorporated into the Work include, but are not limited to, the
      following:
         a. Crane Co.; Crane Valve Group; Crane Valves.
         b. Crane Co.; Crane Valve Group; Jenkins Valves.
         c. Crane Co.; Crane Valve Group; Stockham Division.
         d. Hammond Valve.
         e. Kitz Corporation.
         f. Legend Valve.
         g. Milwaukee Valve Company.
         h. NIBCO INC.
         i. Powell Valves.
         j. Red-White Valve Corporation.
         k. Sure Flow Equipment Inc.
         l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
         m. Zy-Tech Global Industries, Inc.
   2. 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.

2.06 IRON, GROOVED-END SWING CHECK VALVES
A. 300 CWP, Iron, Grooved-End Swing Check Valves:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Anvil International, Inc.
      b. Shurjoint Piping Products.
      c. Tyco Fire Products LP; Grinnell Mechanical Products.
      d. Victaulic Company.
   2. Description:
      a. CWP Rating: 300 psig.
      c. Seal: EPDM.
      d. Disc: Spring-operated, ductile iron or stainless steel.

PART 3 EXECUTION
3.01 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.

3.02 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.

3.03 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.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS
A. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball.
   2. Throttling Service: Ball.
      a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
      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, metal or resilient-seat check valves.
B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:
1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.
7. For Grooved-End Steel Piping: Valve ends may be grooved.

3.05 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two or Three piece, full port, brass or bronze with stainless-steel trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:
1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron, Grooved-End Butterfly Valves: 175 CWP.
3. Iron Swing Check Valves: Class 125, metal seats.
4. Iron, Grooved-End Swing Check Valves: 300 CWP.

END OF SECTION 22 05 23.12
SECTION 22 05 29
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

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

1.02 SUMMARY
A. Section Includes:
1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
B. Related Sections:
1. Section 05 50 00 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.03 DEFINITIONS
A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.04 PERFORMANCE REQUIREMENTS
A. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
   1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
   2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

PART 2 PRODUCTS

2.01 METAL PIPE HANGERS AND SUPPORTS
A. Carbon-Steel Pipe Hangers and Supports:
   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
   3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
   4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
B. Stainless-Steel Pipe Hangers and Supports:
   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
C. Copper Pipe Hangers:
   1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.

2.02 TRAPEZE PIPE HANGERS
A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.
2.03 METAL FRAMING SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Allied Tube & Conduit.
   2. Cooper B-Line, Inc.
   3. Flex-Strut Inc.
   4. GS Metals Corp.
   5. Thomas & Betts Corporation.
   6. Unistrut Corporation; Tyco International, Ltd.
   7. Wesanco, Inc.
   8. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
   10. Channels: Continuous slotted steel channel with inturned lips.
   11. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

B. Non-MFMA Manufacturer Metal Framing Systems:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Anvil International; a subsidiary of Mueller Water Products Inc.
      b. Empire Industries, Inc.
      c. ERICO International Corporation.
      d. Haydon Corporation; H-Strut Division.
      e. NIBCO INC.
      f. PHD Manufacturing, Inc.
      g. PHS Industries, Inc.
   2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
   4. Channels: Continuous slotted steel channel with inturned lips.
   5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

2.04 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Carpenter & Paterson, Inc.
   3. ERICO International Corporation.
   5. PHS Industries, Inc.
   6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
   7. Piping Technology & Products, Inc.
   8. Rilco Manufacturing Co., Inc.
   9. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.05 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.06 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:
   1. Install 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. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Install lateral bracing with pipe hangers and supports to prevent swaying.
I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

L. Insulated Piping:
   1. Attach clamps and spacers to piping.  
      a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
      b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
      c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
   2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
   3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
   4. Shield Dimensions for Pipe: Not less than the following:
      a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
      b. NPS 4: 12 inches long and 0.06 inch thick.
      c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
      d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
   6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.02 METAL FABRICATIONS
A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.03 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.
3.04 PAINTING
A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 09 91 23 "Interior Painting."
C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.05 HANGER AND SUPPORT SCHEDULE
A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
E. Use carbon-steel pipe hangers and supports and attachments for general service applications.
F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.
G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
H. Use padded hangers for piping that is subject to scratching.
I. Use thermal-hanger shield inserts for insulated piping and tubing.
J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
   2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
   3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
   4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
   5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
   6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
   7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel 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.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
   a. Light (MSS Type 31): 750 lb.
   b. Medium (MSS Type 32): 1500 lb.
   c. Heavy (MSS Type 33): 3000 lb.
13. 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.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
   2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
   3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 22 05 29
SECTION 22 05 53
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

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

1.02 SUMMARY
   A. Section Includes:
      1. Equipment labels.
      2. Pipe labels.
      3. Valve tags.

1.03 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

2.01 EQUIPMENT LABELS
   A. Metal Labels for Equipment:
      1. Material and Thickness: Brass, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
      2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
      3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
      5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
   B. Plastic Labels for Equipment:
      1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
      2. Letter Color: Black.
      4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
      5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
      6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
      7. Fasteners: Stainless-steel rivets or self-tapping screws.
      8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
   C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

2.02 PIPE LABELS
   A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.

2.03 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
   1. Tag Material: Brass, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass wire-link or beaded chain; or S-hook.

PART 3 EXECUTION

3.01 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.

3.02 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.03 PIPE LABEL INSTALLATION

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
   1. Near each valve and control device.
   2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
   3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
   4. At access doors, manholes, and similar access points that permit view of concealed piping.
   5. Near major equipment items and other points of origination and termination.
   6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

B. Pipe Label Color Schedule:
   1. Domestic Water Piping:
      b. Letter Color: Black.
   2. Sanitary Waste and Storm Drainage Piping:
      b. Letter Color: Black.

3.04 VALVE - TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

2. Valve-Tag Color:
   b. Hot Water: Natural.

3. Letter Color:
   b. Hot Water: Black.

END OF SECTION 22 05 53
PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes insulating the following plumbing piping services:
   1. Domestic cold-water piping.
   2. Domestic hot-water piping.
   3. Domestic recirculating hot-water piping.
   4. Roof drains and rainwater leaders.
   5. Supplies and drains for handicap-accessible lavatories and sinks.

1.03 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

B. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1.04 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.

1.05 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.06 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

2.01 INSULATION MATERIALS


B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Mineral-Fiber Blanket 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. **Products**: Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corp.; SoftTouch Duct Wrap.
      b. Johns Manville; Microlite.
      c. Knauf Insulation; Friendly Feel Duct Wrap.
      d. Manson Insulation Inc.; Alley Wrap.
      e. Owens Corning; SOFTR All-Service Duct Wrap.

G. Mineral-Fiber, Preformed Pipe Insulation:
   1. **Products**: Subject to compliance with requirements, provide one of the following:
      a. Fibrex Insulations Inc.; Coreplus 1200.
      b. Johns Manville; Micro-Lok.
      c. Knauf Insulation; 1000-Degree Pipe Insulation.
      d. Manson Insulation Inc.; Alley-K.
      e. Owens Corning; Fiberglas Pipe Insulation.
   2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

### 2.02 INSULATING CEMENTS

   1. **Products**: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Ramco Insulation, Inc.; Super-Stik.

   1. **Products**: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

### 2.03 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
   1. **Products**: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      b. Eagle Bridges - Marathon Industries; 225.
      d. Mon-Eco Industries, Inc.; 22-25.

   1. **Products**: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
b. Eagle Bridges - Marathon Industries; 225.
d. Mon-Eco Industries, Inc.; 22-25.

D. PVC Jacket Adhesive: Compatible with PVC jacket.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Dow Corning Corporation; 739, Dow Silicone.
      d. Speedline Corporation; Polyco VP Adhesive.

2.04 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      b. Vimasco Corporation; 749.
   2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 180 deg F.
   4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      b. Eagle Bridges - Marathon Industries; 501.
      d. Mon-Eco Industries, Inc.; 55-10.
   2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
   3. Service Temperature Range: 0 to 180 deg F.

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      b. Eagle Bridges - Marathon Industries; 550.
      e. Vimasco Corporation; WC-1/WC-5.
   2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 180 deg F.
   4. Solids Content: 60 percent by volume and 66 percent by weight.
2.05 SEALANTS
A. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
   1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   2. Materials shall be compatible with insulation materials, jackets, and substrates.
   3. Fire- and water-resistant, flexible, elastomeric sealant.
   4. Service Temperature Range: Minus 40 to plus 250 deg F.

2.06 FACTORY-APPLIED JACKETS
A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
   2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
   3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.07 FIELD-APPLIED FABRIC-REINFORCING MESH
A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.
   1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

2.08 FIELD-APPLIED CLOTHS
A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..
   1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

2.09 FIELD-APPLIED JACKETS
A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
   1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Johns Manville; Zeston.
      c. Proto Corporation; LoSmoke.
      d. Speedline Corporation; SmokeSafe.
   2. Adhesive: As recommended by jacket material manufacturer.
   4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
      a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
2.10 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. ABI, Ideal Tape Division; 428 AWF ASJ.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
   c. Compac Corporation; 104 and 105.
   d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
2. **Width:** 3 inches.
3. **Thickness:** 11.5 mils.
4. **Adhesion:** 90 ounces force/inch in width.
5. **Elongation:** 2 percent.
6. **Tensile Strength:** 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. ABI, Ideal Tape Division; 370 White PVC tape.
   b. Compac Corporation; 130.
   c. Venture Tape; 1506 CW NS.
2. **Width:** 2 inches.
3. **Thickness:** 6 mils.
4. **Adhesion:** 64 ounces force/inch in width.
5. **Elongation:** 500 percent.
6. **Tensile Strength:** 18 lbf/inch in width.

2.11 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:
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. Engineered Brass Company.
   b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
   c. McGuire Manufacturing.
   d. Plumberex.
   e. Truebro; a brand of IPS Corporation.
   f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
2. **Description:** Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:
1. **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. Truebro; a brand of IPS Corporation.
   b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
2. **Description:** Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.
PART 3 EXECUTION

3.01 EXAMINATION
A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
   1. Verify that systems to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION
A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
   1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

3.03 GENERAL INSTALLATION REQUIREMENTS
A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
E. Install multiple layers of insulation with longitudinal and end seams staggered.
F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
G. Keep insulation materials dry during application and finishing.
H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
I. Install insulation with least number of joints practical.
J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
L. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
   a. For below-ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer’s written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
P. For above-ambient services, do not install insulation to the following:
   1. Vibration-control devices.
   2. Testing agency labels and stamps.
   3. Nameplates and data plates.

3.04 PENETRATIONS
A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.
B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
   4. Seal jacket to wall flashing with flashing sealant.
D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
   1. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
F. Insulation Installation at Floor Penetrations:
   1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.05 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
   1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
   2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
   3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
   4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
   5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
   6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
   7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
   8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
   9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

3.06 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
   2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
   3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer’s recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.07 FIELD-APPLIED JACKET INSTALLATION
A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer’s recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches O.C. and at end joints.

C. Install PVC jackets in:
1. Any exposed piping in areas where piping insulation is likely to be damaged. All exposed piping in the Gymnasium shall have PVC jacketing.
2. All exposed piping in mechanical rooms or storage closets below 9’ shall be covered with PVC jacketing.
3. All exposed piping below 9’ in occupied spaces. (not covered above).

3.08 FINISHES
A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

3.09 PIPING INSULATION SCHEDULE, GENERAL
A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### 3.10 INDOOR PIPING INSULATION SCHEDULE

#### A. Domestic Cold Water:
1. NPS 1 and Smaller: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
2. NPS 1-1/4 and Larger: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

#### B. Domestic Hot and Recirculated Hot Water:
1. NPS 1-1/4 and Smaller: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
2. NPS 1-1/2 and Larger: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

#### C. Stormwater and Overflow:
1. All Pipe Sizes: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

#### D. Roof Drain and Overflow Drain Bodies:
1. All Pipe Sizes: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

#### E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
1. All Pipe Sizes: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

#### F. Wall box traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:
1. All Pipe Sizes: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

### 3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

#### A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

#### B. If more than one material is listed, selection from materials listed is Contractor's option.

#### C. Piping, Exposed:
1. PVC, Color-Coded by System: 20 mils thick.

**END OF SECTION 22 07 19**
SECTION 22 11 16
DOMESTIC WATER PIPING

PART 1  GENERAL

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

1.02  SUMMARY
   A. Section Includes:
      1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.

1.03  ACTION SUBMITTALS
   A. Product Data: For transition fittings and dielectric fittings.

1.04  INFORMATIONAL SUBMITTALS
   A. System purging and disinfecting activities report.
   B. Field quality-control reports.

PART 2  PRODUCTS

2.01  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.
   B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.02  COPPER TUBE AND FITTINGS
   A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
   C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
   D. Copper Unions:
      1. MSS SP-123.
      4. Solder-joint or threaded ends.

2.03  PIPING JOINING MATERIALS
   A. Solder Filler Metals: ASTM B 32, lead-free alloys.
   B. Flux: ASTM B 813, water flushable.
   C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.04  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.
   B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
   C. Sleeve-Type Transition Coupling: AWWA C219.
      1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         a. Cascade Waterworks Manufacturing.
b. Dresser, Inc.; Piping Specialties Products.
c. Ford Meter Box Company, Inc. (The).
d. JCM Industries.
e. Romac Industries, Inc.
f. Smith-Blair, Inc.; a Sensus company.
g. Viking Johnson.

2.05 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
      b. Central Plastics Company.
      d. Jomar International.
      e. Matco-Norca.
      g. Watts; a division of Watts Water Technologies, Inc.
      h. Wilkins; a Zurn company.

   3. Pressure Rating: 150 PSIG.

C. Dielectric Flanges:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
      b. Central Plastics Company.
      c. Matco-Norca.
      d. Watts; a division of Watts Water Technologies, Inc.
      e. Wilkins; a Zurn company.

   3. Factory-fabricated, bolted, companion-flange assembly.
   4. Pressure Rating: 150 PSIG.
   5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Central Plastics Company.
      d. Pipeline Seal and Insulator, Inc.

   2. Nonconductive materials for field assembly of companion flanges.
   4. Gasket: Neoprene or phenolic.
   5. Bolt Sleeves: Phenolic or polyethylene.

E. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Elster Perfection Corporation.
   b. Grinnell Mechanical Products; Tyco Fire Products LP.
   c. Matco-Norca.
   d. Precision Plumbing Products, Inc.
   e. Victaulic Company.


3. Electroplated steel nipple complying with ASTM F 1545.

4. Pressure Rating and Temperature: 300 psig at 225 deg F.

5. End Connections: Male threaded or grooved.


PART 3 EXECUTION

3.01 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."

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 for pressure gages in Section 22 05 19 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 22 11 19 "Domestic Water Piping Specialties."

D. Install shutoff valve immediately upstream of each dielectric fitting.

E. Install domestic water piping level and plumb.

F. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

H. 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.

I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

J. Install piping to permit valve servicing.

K. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

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 for thermometers in Section 22 05 19 "Meters and Gages for Plumbing Piping."

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

3.02 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. Soldered Joints for Copper Tubing: 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."
D. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.03 TRANSITION FITTING INSTALLATION
A. Install transition couplings at joints of dissimilar piping.
B. Transition Fittings in Underground Domestic Water Piping:
   1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
   2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

3.04 DIELECTRIC FITTING INSTALLATION
A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.
C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.05 HANGER AND SUPPORT INSTALLATION
A. Comply with requirements for pipe hanger, support products, and installation in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
   1. Vertical Piping: MSS Type 8 or 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.
B. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
C. 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.
   4. NPS 2-1/2: 108 inches with 1/2-inch rod.
   5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
D. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.06 CONNECTIONS
A. Drawings indicate general arrangement of piping, fittings, and specialties.
B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
   1. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
   2. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.07 IDENTIFICATION
   A. Identify system components. Comply with requirements for identification materials and installation in Section 22 05 53 "Identification for Plumbing Piping and Equipment."
   B. Label pressure piping with system operating pressure.

3.08 FIELD QUALITY CONTROL
   A. Perform the following tests and inspections:
      1. Piping Inspections:
         a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
         b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
            1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
            2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
         c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
         d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
      2. Piping Tests:
         a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
         b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
         c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
         d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
         e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
         f. Prepare reports for tests and for corrective action required.
   B. Domestic water piping will be considered defective if it does not pass tests and inspections.
   C. Prepare test and inspection reports.

3.09 ADJUSTING
   A. Perform the following adjustments before operation:
      1. Close drain valves, hydrants, and hose bibbs.
      2. Open shutoff valves to fully open position.
      3. Open throttling valves to proper setting.
      4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 CLEANING
A. Clean and disinfect potable domestic water piping as follows:
   1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
   2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
      a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
      b. Fill and isolate system according to either of the following:
         1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
         2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
      c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
      d. Repeat procedures if biological examination shows contamination.
      e. Submit water samples in sterile bottles to authorities having jurisdiction.
B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 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. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
   1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.
D. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:
   1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.

3.12 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 or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
   2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 22 11 16
SECTION 22 11 19
DOMESTIC WATER PIPING SPECIALTIES

PART 1  GENERAL

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

1.02  SUMMARY
   A. Section Includes:
      1. Vacuum breakers.
      2. Balancing valves.
      3. Temperature Actuated Water Mixing Valves.
      4. Strainers.
      5. Outlet Boxes.
      6. Wall hydrants.
      7. Drain valves.
      8. Water-hammer arresters.

1.03  ACTION SUBMITTALS
   A. Product Data: For each type of product.

1.04  INFORMATIONAL SUBMITTALS
   A. Field quality-control reports.

1.05  CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For domestic water piping specialties to include in
      emergency, operation, and maintenance manuals. NOT NECESSARY FOR : Water hammer
      arrestors, flexible connections, outlet boxes.

PART 2  PRODUCTS

2.01  GENERAL REQUIREMENTS FOR PIPING SPECIALTIES
   A. Potable-water piping and components shall comply with NSF 61.

2.02  PERFORMANCE REQUIREMENTS
   A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise
      indicated.

2.03  VACUUM BREAKERS
   A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
      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. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
            b. Cash Acme; a division of Reliance Worldwide Corporation.
            c. Conbraco Industries, Inc.
            d. FEBCO; a division of Watts Water Technologies, Inc.
            e. Rain Bird Corporation.
            f. Toro Company (The); Irrigation Div.
            g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
            h. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
      3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
      5. Inlet and Outlet Connections: Threaded.
6. Finish: Chrome plated.

B. Hose-Connection Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Arrowhead Brass Products.
   b. Cash Acme; a division of Reliance Worldwide Corporation.
   c. Conbraco Industries, Inc.
   d. Legend Valve.
   e. MIFAB, Inc.
   f. Prier Products, Inc.
   g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
   h. Woodford Manufacturing Company; a division of WCM Industries, Inc.
   i. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
   j. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
5. Finish: Chrome or nickel plated.

2.04 BALANCING VALVES
A. Copper-Alloy Calibrated Balancing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Flo Fab Inc.
   c. ITT Corporation; Bell & Gossett Div.
   d. NIBCO Inc.
   e. TAC.
   f. TACO Incorporated.
   g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
2. Type: Ball valve with two readout ports and memory-setting indicator.
3. Body: Brass or bronze.
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
B. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.05 TEMPERATURE-ACTUATED, WATER MIXING VALVES
A. Individual-Fixture, Water Tempering Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cash Acme; a division of Reliance Worldwide Corporation.
   b. Conbraco Industries, Inc.
   c. Honeywell International Inc.
   d. Lawler Manufacturing Company, Inc.
   e. Leonard Valve Company.
   f. Powers; a division of Watts Water Technologies, Inc.
   g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
   h. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
   i. <Insert manufacturer's name>.
2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.
8. Tempered-Water Setting: 105 deg F.

2.06 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:
   1. Pressure Rating: 125 psig minimum unless otherwise indicated.
   2. Body: Bronze for NPS 2 and smaller; cast iron for NPS 2-1/2 and larger.
   3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
   4. Screen: Stainless steel with round perforations unless otherwise indicated.
   5. Perforation Size:
      a. Strainers NPS 2 and Smaller: 0.020 inch.

2.07 OUTLET BOXES

A. Condensate Drain Outlet Boxes:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the
      following available manufacturers offering products that may be incorporated into the Work
      include, but are not limited to, the following:
   3. Material and Finish: as indicated on the drawings.

2.08 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product
      indicated on Drawings or comparable product by one of the following:
      b. MIFAB, Inc.
      c. Prier Products, Inc.
      e. Tyler Pipe; Wade Div.
      f. Watts Drainage Products.
      g. Woodford Manufacturing Company; a division of WCM Industries, Inc.
      h. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
      i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.

2.09 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:
   2. Pressure Rating: 400-psig minimum CWP.
   4. Body: Copper alloy.
   5. Ball: Chrome-plated brass.
   8. Inlet: Threaded or solder joint.
   9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and
      cap with brass chain.

B. Stop-and-Waste Drain Valves:
   1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
   2. Pressure Rating: 200-psig minimum CWP or Class 125.
   5. Drain: NPS 1/8 side outlet with cap.
2.10 WATER-HAMMER ARRESTERS
A. Water-Hammer Arresters:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AMTROL, Inc.
      b. Josam Company.
      c. MIFAB, Inc.
      d. Precision Plumbing Products, Inc.
      e. Sioux Chief Manufacturing Company, Inc.
      g. Tyler Pipe; Wade Div.
      h. Watts Drainage Products.
      i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
   3. Type: Copper tube with piston.
   4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.11 FLEXIBLE CONNECTORS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Flex-Hose Co., Inc.
   2. Flexicraft Industries.
   3. Flex Pression, Ltd.
   4. Flex-Weld Incorporated.
   5. Hyspan Precision Products, Inc.
   7. Metraflex, Inc.
   8. Proco Products, Inc.
   9. TOZEN Corporation.
   10. Unaflex, Universal Metal Hose; a Hyspan company.
B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
   2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
   3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

PART 3 EXECUTION
3.01 INSTALLATION
A. Install 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 unacceptable for this application.
   3. Do not install bypass piping around backflow preventers.
B. Install balancing valves in locations where they can easily be adjusted.
C. Install Y-pattern strainers for water on supply side of each pump.
D. Install water-hammer arresters in water piping according to PDI-WH 201.
E. Install air vents at high points of water piping.
3.02 CONNECTIONS
   A. Comply with requirements for ground equipment in Section 26 05 26 "Grounding and Bonding for Electrical Systems."
   B. Fire-retardant-treated-wood blocking is specified in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

3.03 LABELING AND IDENTIFYING
   A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
      1. Reduced-pressure-principle backflow preventers.
      2. Double-check, backflow-prevention assemblies.
      3. Calibrated balancing valves.

3.04 FIELD QUALITY CONTROL
   A. Perform the following tests and inspections:
      1. Test each reduced-pressure-principle backflow preventer and double-check, backflow-prevention assembly according to authorities having jurisdiction and the device’s reference standard.
   B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
   C. Prepare test and inspection reports.

3.05 ADJUSTING
   A. Set field-adjustable flow set points of balancing valves.

END OF SECTION 22 11 19
PART 1  GENERAL

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

1.02  SUMMARY
   A. Section Includes:
      1. Pipe, tube, and fittings.
      2. Specialty pipe fittings.

1.03  PERFORMANCE REQUIREMENTS
   A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1.04  QUALITY ASSURANCE
   A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.05  PROJECT CONDITIONS
   A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
      1. Notify Architect Construction Manager Owner no fewer than two days in advance of proposed interruption of sanitary waste service.

PART 2  PRODUCTS

2.01  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.

2.02  HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS
   A. Pipe and Fittings: ASTM A 74, Service class(es).
   B. Gaskets: ASTM C 564, rubber.
   C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.03  HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS
   A. Pipe and Fittings: ASTM A 888 or CISPI 301.
   B. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.
   C. CISPI, Hubless-Piping Couplings:
      1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         a. ANACO-Husky.
         c. Fernco Inc.
         d. Matco-Norca, Inc.
         e. MIFAB, Inc.
         f. Mission Rubber Company; a division of MCP Industries, Inc.
         g. Stant.
h. Tyler Pipe.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. Cast-Iron, Hubless-Piping Couplings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. MG Piping Products Company.
3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.04 COPPER TUBE AND FITTINGS
A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
C. Hard Copper Tube: ASTM B 88, Type L and Type M, water tube, drawn temper.
D. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.
E. Copper Pressure Fittings:
   2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
F. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
   1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
   2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
G. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.05 ABS PIPE AND FITTINGS
A. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.
B. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.
C. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.
D. Solvent Cement: ASTM D 2325.
   1. ABS solvent cement shall have a VOC content of 325 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services’ "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.06 PVC PIPE AND FITTINGS
A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
C. Adhesive Primer: ASTM F 656.
   1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services’ "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
D. Solvent Cement: ASTM D 2564.
1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

### 2.07 SPECIALTY PIPE FITTINGS

#### A. Transition Couplings:
1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      2) Fernco Inc.
      3) Mission Rubber Company; a division of MCP Industries, Inc.
      4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
   c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
   d. Sleeve Materials:
      2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
      3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
   e. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      2) Mission Rubber Company; a division of MCP Industries, Inc.
   g. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

#### B. Dielectric Fittings:
1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Capitol Manufacturing Company.
      2) Central Plastics Company.
      3) Hart Industries International, Inc.
      4) Jomar International Ltd.
      5) Matco-Norca, Inc.
      7) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
      8) Wilkins; a Zurn company.
   b. Description:
      1) Standard: ASSE 1079.
      2) Pressure Rating: 125 psig minimum at 180 deg F.
3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. Dielectric Flanges:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Capitol Manufacturing Company.
      2) Central Plastics Company.
      3) Matco-Norca, Inc.
      4) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
      5) Wilkins; a Zurn company.
   b. Description:
      1) Standard: ASSE 1079.
      2) Factory-fabricated, bolted, companion-flange assembly.
      3) Pressure Rating: 125 psig minimum at 180 deg F.
      4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Advance Products & Systems, Inc.
      2) Calpico, Inc.
      3) Central Plastics Company.
      4) Pipeline Seal and Insulator, Inc.
   b. Description:
      1) Nonconducting materials for field assembly of companion flanges.
      2) Pressure Rating: 150 psig.
      3) Gasket: Neoprene or phenolic.
      4) Bolt Sleeves: Phenolic or polyethylene.
      5) Washers: Phenolic with steel backing washers.

5. Dielectric Nipples:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Elster Perfection.
      2) Grinnell Mechanical Products.
      3) Matco-Norca, Inc.
      4) Precision Plumbing Products, Inc.
      5) Victaulic Company.
   b. Description:
      1) Standard: IAPMO PS 66.
      2) Electroplated steel nipple.
      3) Pressure Rating: 300 psig at 225 deg F.
      4) End Connections: Male threaded or grooved.
      5) Lining: Inert and noncorrosive, propylene.

PART 3 EXECUTION

3.01 EARTH MOVING
   A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 20 00 "Earth Moving."

3.02 PIPING INSTALLATION
   A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. 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 two 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; 2 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. 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."

N. Install steel piping according to applicable plumbing code.

O. Install stainless-steel piping according to ASME A112.3.1 and applicable plumbing code.

P. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

Q. Install underground PVC piping according to ASTM D 2321.

R. Install engineered soil and waste drainage and vent piping systems as follows:
   2. Sovent Drainage System: Comply with ASSE 1043 and sovent fitting manufacturer's written installation instructions.
   3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

S. Plumbing Specialties:
   1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
T. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

3.03 JOINT CONSTRUCTION


C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

D. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

E. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

F. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
   3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.04 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:
   1. Install transition couplings at joints of piping with small differences in OD's.
   4. In Underground Force Main Piping:
      a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
      b. NPS 2 and Larger: Pressure transition couplings.

B. Dielectric Fittings:
   1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
   2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples unions.
   3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges flange kits nipples.
   4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.05 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
   1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
   2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
   3. Vertical Piping: MSS Type 8 or Type 42, clamps.
   4. Install individual, straight, horizontal piping runs:
SANITARY WASTE AND VENT

5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

F. 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: 60 inches with 3/8-inch rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
   4. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4: 84 inches with 3/8-inch rod.
   2. NPS 1-1/2: 108 inches with 3/8-inch rod.
   3. NPS 2: 10 feet with 3/8-inch rod.
   4. NPS 2-1/2: 11 feet with 1/2-inch rod.
   5. NPS 3: 12 feet with 1/2-inch rod.
   6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.

I. Install supports for vertical steel piping every 15 feet.

J. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 2: 84 inches with 3/8-inch rod.
   2. NPS 3: 96 inches with 1/2-inch rod.
   3. NPS 4: 108 inches with 1/2-inch rod.

K. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4: 72 inches with 3/8-inch rod.
   2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
   3. NPS 2-1/2: 108 inches with 1/2-inch rod.
   4. NPS 3 and NPS 5: 10 feet with 1/2-inch rod.

L. Install supports for vertical copper tubing every 10 feet.

M. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.06 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. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.

5. 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 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.07 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.08 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. 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. 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.

3.09 CLEANING AND PROTECTION

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.
D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.10 PIPING SCHEDULE
A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
B. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:
   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
   2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
   3. Copper DWV tube, copper drainage fittings, and soldered joints.
C. Aboveground, vent piping NPS 4 and smaller shall be the following:
   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
   2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
   3. Copper DWV tube, copper drainage fittings, and soldered joints.
      a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2: Hard copper tube, Type M; copper pressure fittings; and soldered joints.
D. Underground, soil, waste, and vent piping NPS 4 and smaller shall be the following:
   1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
   2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
   3. Stainless-steel pipe and fittings, gaskets, and gasketed joints.
   4. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION 22 13 16
SECTION 22 13 19
SANITARY WASTE PIPING SPECIALTIES

PART 1  GENERAL

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

1.02 SUMMARY
   A. Section Includes:
   B. Section Includes:
      1. Cleanouts.
      2. Floor drains.
      3. Roof flashing assemblies.
      4. Through-penetration firestop assemblies.
      5. Miscellaneous sanitary drainage piping specialties.
      6. Flashing materials.
   C. Related Requirements:
      1. Section 22 14 23 "Storm Drainage Piping Specialties" for storm drainage piping inside the
         building, drainage piping specialties, and drains.

1.03 DEFINITIONS
   B. FOG: Fats, oils, and greases.
   C. FRP: Fiberglass-reinforced plastic.
   D. HDPE: High-density polyethylene plastic.
   E. PE: Polyethylene plastic.
   F. PP: Polypropylene plastic.
   G. PVC: Polyvinyl chloride plastic.

1.04 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated. Include rated capacities, operating
      characteristics, and accessories for the following:
      1. Floor drains
      2. Clean outs

1.05 QUALITY ASSURANCE
   A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing
      agency.
   B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70,
      Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for
      intended use.
   C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary
      piping specialty components.

1.06 COORDINATION
   A. Coordinate size and location of roof penetrations.

PART 2  PRODUCTS

2.01 CLEANOUTS
   A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated
      on Drawings or comparable product by one of the following:
      1. Josam Company.
2. MIFAB, Inc.
4. Tyler Pipe, Wade division.
5. Watts Drainage Products.

2.02 FLOOR DRAINS
A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Commercial Enameling Co.
   2. Josam Company; Josam Div.
   3. MIFAB, Inc.
   4. Prier Products, Inc.
   6. Tyler Pipe; Wade Div.
   7. Watts Drainage Products.
   8. Zurn Plumbing Products Group.

2.03 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES
A. Open Drains:
   1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
   2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Deep-Seal Traps:
   1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
   2. Size: Same as connected waste piping.
      a. NPS 2: 4-inch-minimum water seal.
      b. NPS 2-1/2 and Larger: 5-inch-minimum water seal.

C. Air-Gap Fittings:
   1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
   2. Body: Bronze or cast iron.
   3. Inlet: Opening in top of body.
   4. Outlet: Larger than inlet.
   5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

D. Sleeve Flashing Device:
   1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
   2. Size: As required for close fit to riser or stack piping.

E. Stack Flashing Fittings:
   1. Description: Counterflashign-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
   2. Size: Same as connected stack vent or vent stack.

2.04 INSTALLATION
A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
   1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.
B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
D. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
   1. Position floor drains for easy access and maintenance.
   2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
   3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
   4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
E. Install deep-seal traps on floor drains and other waste outlets, if indicated.
F. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
G. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
H. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

2.05 CONNECTIONS
   A. Comply with requirements in Section 22 13 16 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
   B. Install piping adjacent to equipment to allow service and maintenance.
   C. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
   D. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

2.06 FIELD QUALITY CONTROL
   A. Perform tests and inspections and prepare test reports.
   B. Tests and Inspections:
      1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
      2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

2.07 PROTECTION
   A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
   B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 13 19
SECTION 22 42 13.13
COMMERCIAL WATER CLOSETS

PART 1 GENERAL

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

2.02 SUMMARY
A. Section Includes:
1. Water closets.
2. Flushometer valves.
3. Toilet seats.
4. Supports.

2.03 DEFINITIONS
A. Effective Flush Volume: Average of two reduced flushes and one full flush per fixture.

2.04 ACTION SUBMITTALS
A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
   3. Product Data: For water consumption

2.05 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For flushometer valves to include in operation and maintenance manuals.

PART 2 PRODUCTS

3.01 WALL-MOUNTED WATER CLOSETS
A. Water Closets: Wall mounted, top spud.
   3. Type: Siphon jet.
   5. Height: Standard.
   7. Water Consumption: 1.6 gal. per flush.
   8. Spud Size and Location: NPS 1-1/2; top.
   12. Water-Closet Mounting Height: Refer to drawings for mounting heights.

3.02 FLUSHOMETER VALVES
A. Lever-Handle, Diaphragm Flushometer Valves:
   3. Features: Include integral check stop and backflow-prevention device.
   5. Exposed Flushometer-Valve Finish: Chrome plated.
   6. Panel Finish: Chrome plated or stainless steel.
7. Style: Exposed.
8. Consumption: 1.6 gal. per flush.

3.03 TOILET SEATS
A. Toilet Seats <Insert drawing designation>:
   3. Type: Commercial (Standard).
   4. Shape: Elongated rim, open front.
   5. Hinge: Check.
   7. Seat Cover: Not required.

3.04 SUPPORTS
A. Water Closet Carrier:
   1. Standard: ASME A112.6.1M.
   2. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

PART 3 EXECUTION
4.01 EXAMINATION
A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.
B. Examine walls and floors for suitable conditions where water closets will be installed.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

4.02 INSTALLATION
A. Water-Closet Installation:
   1. Install level and plumb according to roughing-in drawings.
   2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
   3. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.
B. Support Installation:
   1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
   2. Use carrier supports with waste-fitting assembly and seal.
   3. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.
C. Flushometer-Valve Installation:
   1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
   2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
   3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
D. Install toilet seats on water closets.
E. Wall Flange and Escutcheon Installation:
   1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
   2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

F. Joint Sealing:
   1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
   2. Match sealant color to water-closet color.
   3. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

4.03 CONNECTIONS
A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.
B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."
C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."
D. Where installing piping adjacent to water closets, allow space for service and maintenance.

4.04 ADJUSTING
A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.
B. Adjust water pressure at flushometer valves to produce proper flow.
C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

4.05 CLEANING AND PROTECTION
A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.
B. Install protective covering for installed water closets and fittings.
C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 42 13.13
PART 1 GENERAL

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

1.02 SUMMARY
   A. Section Includes:
      1. Urinals.
      2. Flushometer valves.
   B. Related Requirements:
      1. Section 22 46 00 "Security Plumbing Fixtures" for security urinals.

1.03 ACTION SUBMITTALS
   A. Product Data: For each type of product.
      1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for urinals.
      2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
   B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.04 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For flushometer valves to include in operation and maintenance manuals.

PART 2 PRODUCTS

2.01 WALL-HUNG URINALS
   A. Urinals: Wall hung, back outlet, blowout.
      1. Fixture:
         b. Material: Vitreous china.
         c. Strainer or Trapway: Manufacturer's standard strainer with integral trap.
         e. Spud Size and Location: NPS 1-1/4; top.
         f. Outlet Size and Location: NPS 2; back.
         g. Color: White.
      2. Flushometer Valve.
      3. Waste Fitting:
         b. Size: NPS 2.
      4. Support: Type I Urinal Carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture.
      5. Urinal Mounting Height: Refer to drawings for mounting heights.
   B. Urinals: Wall hung, back outlet, washout.
      1. Fixture:
         b. Material: Vitreous china.
         c. Type: Washout with extended shields.
         d. Strainer or Trapway: Manufacturer's standard strainer with integral trap.
         e. Water Consumption: Low.
         f. Spud Size and Location: NPS 3/4, top.
g. Outlet Size and Location: NPS 2, back.
  h. Color: White.
2. Flushometer Valve.
3. Waste Fitting:
   b. Size: NPS 2.
4. Support: Type I Urinal Carrier with fixture support plates and coupling with seal and fixture
bolts and hardware matching fixture.
5. Urinal Mounting Height: Refer to drawings for mounting heights.

2.02 URINAL FLUSHOMETER VALVES
A. Lever-Handle, Diaphragm Flushometer Valves:
   3. Features: Include integral check stop and backflow-prevention device.
   5. Exposed Flushometer-Valve Finish: Chrome plated.
   6. Panel Finish: Chrome plated or stainless steel.
   7. Style: Exposed.
   8. Consumption: 1.0 gal. per flush.

2.03 SUPPORTS
A. Type I Urinal Carrier:

PART 3 EXECUTION
3.01 EXAMINATION
A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify
actual locations of piping connections before urinal installation.
B. Examine walls and floors for suitable conditions where urinals will be installed.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION
A. Urinal Installation:
   1. Install urinals level and plumb according to roughing-in drawings.
   2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
   3. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly,
      according to ICC/ANSI A117.1.
   4. Install trap-seal liquid in waterless urinals.
B. Support Installation:
   1. Install supports, affixed to building substrate, for wall-hung urinals.
   2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
   3. Use carriers without waste fitting for urinals with tubular waste piping.
   4. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.
C. Flushometer-Valve Installation:
   1. Install flushometer-valve water-supply fitting on each supply to each urinal.
   2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
   3. Install lever-handle flushometer valves for accessible urinals with handle mounted on open
      side of compartment.
D. Wall Flange and Escutcheon Installation:
   1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished
      locations.
   2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

E. Joint Sealing:
   1. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
   2. Match sealant color to urinal color.
   3. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

3.03 CONNECTIONS
   A. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.
   B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."
   C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."
   D. Where installing piping adjacent to urinals, allow space for service and maintenance.

3.04 ADJUSTING
   A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.
   B. Adjust water pressure at flushometer valves to produce proper flow.

3.05 CLEANING AND PROTECTION
   A. Clean urinals and fittings with manufacturers' recommended cleaning methods and materials.
   B. Install protective covering for installed urinals and fittings.
   C. Do not allow use of urinals for temporary facilities unless approved in writing by Owner.

   END OF SECTION 22 42 13.16
PART 1 GENERAL

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

1.02 SUMMARY
   A. Section Includes:
      1. Lavatories.
      2. Faucets.

1.03 ACTION SUBMITTALS
   A. Product Data: For each type of product.
      1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
      2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
   B. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

1.04 INFORMATIONAL SUBMITTALS
   A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.05 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.
      1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
         a. Servicing and adjustments of automatic faucets.

PART 2 PRODUCTS

2.01 LAVATORIES
   A. Lavatory
      1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or approved equal.

2.02 SUPPLY FITTINGS
   A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.
   B. Standard: ASME A112.18.1/CSA B125.1.
   C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.
   D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
   E. Operation: Loose key.
   F. Risers:
      2. Chrome-plated, rigid-copper-pipe and brass straight or offset tailpieces ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser.

2.03 WASTE FITTINGS
   A. Standard: ASME A112.18.2/CSA B125.2.
   B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.
C. Trap:
   2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated, brass or steel wall flange.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.
B. Examine counters and walls for suitable conditions where lavatories will be installed.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install lavatories level and plumb according to roughing-in drawings.
B. Install supports, affixed to building substrate, for wall-mounted lavatories.
C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.
D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."
E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."
F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."

3.03 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."
C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

3.04 ADJUSTING

A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.
B. Adjust water pressure at faucets to produce proper flow.
C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.05 CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.
B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
C. Provide protective covering for installed lavatories and fittings.
D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 42 16.13
PART 1 GENERAL

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

1.02 SUMMARY
   A. Section Includes:
      1. Utility sinks.
      2. Sink faucets.

1.03 ACTION SUBMITTALS
   A. Product Data: For each type of product.
      1. Include construction details, material descriptions, dimensions of individual components
         and profiles, and finishes for sinks.

1.04 CLOSEOUT SUBMITTALS
   A. Maintenance Data: For sinks to include in maintenance manuals.

PART 2 PRODUCTS

2.01 SINKS
   A. Sinks:
      1. Basis-of-Design Product: Subject to compliance with requirements, provide product
         indicated on Drawings or comparable product by one of the following:
         a. Advance Tabco.
         b. Eagle Group; Foodservice Equipment Division.
         c. Elkay Manufacturing Co.
         d. Griffin Products, Inc.
         e. Just Manufacturing.
      2. Fixture:
         b. Type: Ledge back.

2.02 SINK FAUCETS
   A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health
      Effects," for faucet-spout materials that will be in contact with potable water.
   B. Sink Faucets: Manual type, single-control mixing valve.
      1. Faucets.
         a. Basis-of-Design Product: Subject to compliance with requirements, provide product
            indicated on Drawings or comparable product by one of the following:
            1) American Standard America.
            2) Bradley Corporation.
            3) Chicago Faucets.
            4) Delta Faucet Company.
            5) Elkay Manufacturing Co.
            6) Just Manufacturing.
            7) Kohler Co.
            8) Moen Incorporated.
            9) Speakman Company.
            10) Zurn Plumbing Products Group.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.

2.03 SUPPLY FITTINGS
   A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.
   B. Standard: ASME A112.18.1/CSA B125.1.
   C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.
   D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
   E. Operation: Loose key.
   F. Risers:
      1. NPS 3/8
      2. Chrome-plated, rigid-copper pipe or ASME A112.18.6, braided or corrugated stainless-steel flexible hose.

2.04 WASTE FITTINGS
   A. Standard: ASME A112.18.2/CSA B125.2.
   B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.
   C. Trap:
      2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated brass or steel wall flange.

2.05 GROUT
   B. Characteristics: Nonshrink; recommended for interior and exterior applications.
   C. Design Mix: 5000-psi, 28-day compressive strength.
   D. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.
   B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.
   C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION
   A. Install sinks level and plumb according to roughing-in drawings.
   B. Install supports, affixed to building substrate, for wall-hung sinks.
   C. Set floor-mounted sinks in leveling bed of cement grout.
   D. Install water-supply piping with stop on each supply to each sink faucet.
      1. Exception: Use ball, gate, or globe valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 22 05 23 "General-Duty Valves for Plumbing Piping."
      2. Install stops in locations where they can be easily reached for operation.
   E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."
F. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

3.03 CONNECTIONS
A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."
C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

3.04 ADJUSTING
A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.
B. Adjust water pressure at faucets to produce proper flow.

3.05 CLEANING AND PROTECTION
A. After completing installation of sinks, inspect and repair damaged finishes.
B. Clean sinks, faucets, and other fittings with manufacturers’ recommended cleaning methods and materials.
C. Provide protective covering for installed sinks and fittings.
D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 42 16.16
SECTION 23 05 13
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

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

1.02 SUMMARY
A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.03 COORDINATION
A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

PART 2 PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS
A. Comply with NEMA MG 1 unless otherwise indicated.
B. Comply with IEEE 841 for severe-duty motors.

2.02 MOTOR CHARACTERISTICS
A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.03 POLYPHASE MOTORS
A. Description: NEMA MG 1, Design B, medium induction motor.
B. Efficiency: Energy efficient, as defined in NEMA MG 1.
C. Service Factor: 1.15.
D. Multispeed Motors: Variable torque.
   1. For motors with 2:1 speed ratio, consequent pole, single winding.
E. Multispeed Motors: Separate winding for each speed.
F. Rotor: Random-wound, squirrel cage.
G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
H. Temperature Rise: Match insulation rating.
I. Insulation: Class F.
J. Code Letter Designation:
   1. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.
2.04 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
   1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
   2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
   3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
   4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.05 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.
   2. Split phase.
   3. Capacitor start, inductor run.
   4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.06 P3 EXECUTION (NOT APPLICABLE)

END OF SECTION 23 05 13
SECTION 23 05 17
SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 GENERAL
1.01 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary
      Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
   A. Section Includes:
      1. Sleeves and grout

PART 2 PRODUCTS
2.01 SLEEVES
   A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron
      pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
   B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded
      steel collar; zinc coated.
   C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc
      coated, with plain ends.
   E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with
      welded longitudinal joint.
   F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with
      nailing flange for attaching to wooden forms.
   G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.02 GROUT
   A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry,
      hydraulic-cement grout.
   B. Characteristics: Nonshrink; recommended for interior and exterior applications.
   C. Design Mix: 5000-psi, 28-day compressive strength.
   D. Packaging: Premixed and factory packaged.

PART 3 EXECUTION
3.01 SLEEVE INSTALLATION
   A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
   B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to
      provide 1-inch annular clear space between piping and concrete slabs and walls.
      1. Sleeves are not required for core-drilled holes.
   C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and
      walls are constructed.
      1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP
         sleeves.
      2. Cut sleeves to length for mounting flush with both surfaces.
         a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other
            wet areas 2 inches above finished floor level.
      3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal
         system.
   D. Install sleeves for pipes passing through interior partitions.
      1. Cut sleeves to length for mounting flush with both surfaces.
2. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 07 92 00 "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 07 84 13 "Penetration Firestopping."

3.02 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:
   1. Interior Partitions:
      a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves. PVC-pipe sleeves are acceptable if allowed by local AHJ.

END OF SECTION 23 05 17
SECTION 23 05 19
METERS AND GAGES FOR HVAC PIPING

PART 1 GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Liquid-in-glass thermometers.
   2. Thermowells.
   3. Dial-type pressure gages.
   4. Gage attachments.
   5. Test plugs.

1.03 ACTION SUBMITTALS
A. Product Data: For each type of product indicated.

1.04 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 PRODUCTS

2.01 LIQUID-IN-GLASS THERMOMETERS
A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Trerice, H. O. Co.
   3. Case: Cast aluminum; 6-inch nominal size.
   4. Case Form: Back angle unless otherwise indicated.
   5. Tube: Glass with magnifying lens and blue or red organic liquid.
   6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
   7. Window: Glass or plastic.
   8. Stem: Aluminum or brass and of length to suit installation.
      b. Design for Thermowell Installation: Bare stem.
   10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.02 DUCT-THERMOMETER MOUNTING BRACKETS
A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.03 THERMOWELLS
A. Thermowells:
   2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
   3. Material for Use with Copper Tubing: CNR.
   4. Material for Use with Steel Piping: CRES.
   5. Type: Stepped shank unless straight or tapered shank is indicated.
   6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.04 PRESSURE GAGES
A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. AMETEK, Inc.; U.S. Gauge.
   b. Ashcroft Inc.
   c. Ernst Flow Industries.
   d. Flo Fab Inc.
   e. Marsh Bellofram.
   f. Miljoco Corporation.
   g. Noshok.
   h. Palmer Wahl Instrumentation Group.
   i. REOTEMP Instrument Corporation.
   j. Tel-Tru Manufacturing Company.
   k. Trerice, H. O. Co.
   l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   m. Weiss Instruments, Inc.
   n. WIKA Instrument Corporation - USA.
   o. Winters Instruments - U.S.
3. Case: Sealed type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
9. Window: Glass or plastic.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.05 GAGE ATTACHMENTS
A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.06 TEST PLUGS
A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Flow Design, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F

F. Core Inserts: Chlorosulfonated polyethylene synthetic self-sealing rubber.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.

H. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

I. Install remote-mounted pressure gages on panel.

J. Install valve and snubber in piping for each pressure gage for fluids (except steam).

K. Install valve and syphon fitting in piping for each pressure gage for steam.

L. Install test plugs in piping tees.

M. Install flow indicators in piping systems in accessible positions for easy viewing.

N. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.

O. Install flowmeter elements in accessible positions in piping systems.

P. Install wafer-orifice flowmeter elements between pipe flanges.

Q. Install differential-pressure-type flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.

R. Install permanent indicators on walls or brackets in accessible and readable positions.

S. Install connection fittings in accessible locations for attachment to portable indicators.

T. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.

U. Install thermometers in the following locations:
   1. Inlet and outlet of each hydronic zone.
   2. Inlet and outlet of each hydronic boiler.
   3. Two inlets and two outlets of each chiller.
   4. Inlet and outlet of each hydronic coil in air-handling units.
   5. Two inlets and two outlets of each hydronic heat exchanger.
   6. Inlet and outlet of each thermal-storage tank.
   7. Outside-, return-, supply-, and mixed-air ducts.

V. Install pressure gages in the following locations:
   1. Discharge of each pressure-reducing valve.
   2. Inlet and outlet of each chiller chilled-water and condenser-water connection.
3. Suction and discharge of each pump.

3.02 CONNECTIONS
   A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.
   B. Connect flowmeter-system elements to meters.
   C. Connect flowmeter transmitters to meters.
   D. Connect thermal-energy meter transmitters to meters.

3.03 ADJUSTING
   A. After installation, calibrate meters according to manufacturer's written instructions.
   B. Adjust faces of meters and gages to proper angle for best visibility.

3.04 THERMOMETER SCALE-RANGE SCHEDULE
   A. Scale Range for Loop Water Piping: 0 to 100 deg F.

3.05 PRESSURE-GAGE SCALE-RANGE SCHEDULE
   A. Scale Range for Chilled-Water Piping: 0 to 160 psi.

END OF SECTION 23 05 19
SECTION 23 05 23
GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Brass ball valves.
   2. Bronze ball valves.
   4. Bronze swing check valves.
   5. Iron swing check valves.
B. Related Sections:
   1. Section 23 05 53 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.03 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.

1.04 QUALITY ASSURANCE
A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
B. ASME Compliance:
   1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   2. ASME B31.1 for power piping valves.
   3. ASME B31.9 for building services piping valves.

1.05 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

2.01 GENERAL REQUIREMENTS FOR VALVES

A. Refer to HVAC valve schedule articles for applications of valves.
B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
C. Valve Sizes: Same as upstream piping unless otherwise indicated.
D. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
   1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
E. Valve-End Connections:
   1. Flanged: With flanges according to ASME B16.1 for iron valves.
   2. Grooved: With grooves according to AWWA C606.
   3. Threaded: With threads according to ASME B1.20.1.
F. Valve Bypass and Drain Connections: MSS SP-45.

2.02 BRASS BALL VALVES

A. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Crane Co.; Crane Valve Group; Crane Valves.
      b. Crane Co.; Crane Valve Group; Jenkins Valves.
      c. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
      d. Hammond Valve.
      e. Jamesbury; a subsidiary of Metso Automation.
      f. Kitz Corporation.
      g. Marwin Valve; a division of Richards Industries.
      h. Milwaukee Valve Company.
      i. RuB Inc.
   2. Description:
      b. SWP Rating: 150 psig.
      c. CWP Rating: 600 psig.
      d. Body Design: Two piece.
      e. Body Material: Forged brass.
      f. Ends: Threaded.
      g. Seats: PTFE or TFE.
      h. Stem: Stainless steel.
      i. Ball: Stainless steel, vented.
      j. Port: Full.
B. Three-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Jomar International, LTD.
      b. Kitz Corporation.
      c. Marwin Valve; a division of Richards Industries.
      d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   2. Description:
      b. SWP Rating: 150 psig.
      c. CWP Rating: 600 psig.
d. Body Design: Three piece.
e. Body Material: Forged brass.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

2.03 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Crane Co.; Crane Valve Group; Crane Valves.
      c. Hammond Valve.
      d. Lance Valves; a division of Advanced Thermal Systems, Inc.
      e. Milwaukee Valve Company.
      f. NIBCO INC.
      g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   2. Description:
      b. SWP Rating: 150 psig.
      c. CWP Rating: 600 psig.
      d. Body Design: Two piece.
      e. Body Material: Bronze.
      f. Ends: Threaded.
      g. Seats: PTFE or TFE.
      h. Stem: Stainless steel.
      i. Ball: Stainless steel, vented.
      j. Port: Full.

B. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Hammond Valve.
      c. Milwaukee Valve Company.
      d. NIBCO INC.
   2. Description:
      b. SWP Rating: 150 psig.
      c. CWP Rating: 600 psig.
      d. Body Design: Three piece.
      e. Body Material: Bronze.
      f. Ends: Threaded.
      g. Seats: PTFE or TFE.
      h. Stem: Stainless steel.
      i. Ball: Stainless steel, vented.
      j. Port: Full.

2.04 IRON, GROOVED-END BUTTERFLY VALVES

A. 175 CWP, Iron, Grooved-End Butterfly Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Kennedy Valve; a division of McWane, Inc.
      b. Shurjoint Piping Products.
c. Tyco Fire Products LP; Grinnell Mechanical Products.
d. Victaulic Company.

2. Description:
a. Standard: MSS SP-67, Type I.
b. CWP Rating: 175 psig.
c. Body Material: Coated, ductile iron.
e. Disc: Coated, ductile iron.
f. Seal: EPDM.

2.05 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Valve, Inc.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Crane Co.; Crane Valve Group; Jenkins Valves.
   d. Crane Co.; Crane Valve Group; Stockham Division.
   e. Hammond Valve.
   f. Kitz Corporation.
   g. Milwaukee Valve Company.
   h. NIBCO INC.
   i. Powell Valves.
   j. Red-White Valve Corporation.
   k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   l. Zy-Tech Global Industries, Inc.
2. Description:
   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: 200 psig.
   c. Body Design: Horizontal flow.
   e. Ends: Threaded.
   f. Disc: Bronze.

2.06 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. Hammond Valve.
   e. Kitz Corporation.
   f. Legend Valve.
   g. Milwaukee Valve Company.
   h. NIBCO INC.
   i. Powell Valves.
   j. Red-White Valve Corporation.
   k. Sure Flow Equipment Inc.
   l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   m. Zy-Tech Global Industries, Inc.
2. Description:
   a. Standard: MSS SP-71, Type I.
   b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
   c. NPS 14 to NPS 24, CWP Rating: 150 psig.
2.07 IRON, GROOVED-END SWING CHECK VALVES

A. 300 CWP, Iron, Grooved-End Swing Check Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil International, Inc.
      b. Shurjoint Piping Products.
      c. Tyco Fire Products LP; Grinnell Mechanical Products.
      d. Victaulic Company.
   2. Description:
      a. CWP Rating: 300 psig.
      c. Seal: EPDM.
      d. Disc: Spring operated, ductile iron or stainless steel.

PART 3 EXECUTION

3.01 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.

3.02 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.

3.03 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.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball, butterfly, or gate valves.
   2. Butterfly Valve Dead-End Service: Grooved.
   3. Throttling Service except Steam: ball, or butterfly valves.
      a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
      b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal-seat check valves.
B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:
   1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
   2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
   4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
   5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   6. For Steel Piping, NPS 5 and Larger: Flanged ends.
   7. For Grooved-End Steel Piping except Steam and Steam Condensate Piping: Valve ends may be grooved.

3.05 LOOP-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
   1. Ball Valves: Two or Three piece, full port, brass or bronze with stainless-steel trim.
   2. Bronze Swing Check Valves: Class 125, bronze disc.
   3. Bronze Gate Valves: Class 125, NRS, bronze.

B. Pipe NPS 2-1/2 and Larger:
   1. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 12: 175 CWP.
   2. Iron Swing Check Valves: Class 125, metal seats.
   3. Iron, Grooved-End Check Valves, NPS 3 to NPS 12: 300 CWP.
SECTION 23 05 29
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Metal pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Thermal-hanger shield inserts.
   4. Fastener systems.
   5. Equipment supports.
B. Related Sections:
   1. Section 23 05 16 "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
   2. Section 23 31 13 "Metal Ducts" for duct hangers and supports.

1.03 DEFINITIONS
A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

PART 2 PRODUCTS

2.01 METAL PIPE HANGERS AND SUPPORTS
A. Carbon-Steel Pipe Hangers and Supports:
   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
   3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
   4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
B. Stainless-Steel Pipe Hangers and Supports:
   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
C. Copper Pipe Hangers:
   1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.

2.02 TRAPEZE PIPE HANGERS
A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.03 THERMAL-HANGER SHIELD INSERTS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Carpenter & Paterson, Inc.
   3. ERICO International Corporation.
   5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.04 FASTENER SYSTEMS
A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.05 EQUIPMENT SUPPORTS
A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.06 MISCELLANEOUS MATERIALS
A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 EXECUTION
3.01 HANGER AND SUPPORT INSTALLATION
A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:
   1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use
operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.


G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Install lateral bracing with pipe hangers and supports to prevent swaying.

I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

L. Insulated Piping:
   1. Attach clamps and spacers to piping.
      a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
      b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
      c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
   2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
   3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
   4. Shield Dimensions for Pipe: Not less than the following:
      a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
      b. NPS 4: 12 inches long and 0.06 inch thick.
      c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
      d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
      e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
   5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
   6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.02 EQUIPMENT SUPPORTS
   A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
   B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
   C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.03 ADJUSTING
   A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
3.04 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.

G. Use copper-plated pipe hangers and stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
   2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
   3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
   4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
   5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
   6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
   7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.

18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.

19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.

21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.

2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel 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.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.

2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.

3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.

4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.

5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.

6. C-Clamps (MSS Type 23): For structural shapes.

7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.

8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.

9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.

10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.

11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
   a. Light (MSS Type 31): 750 lb.
   b. Medium (MSS Type 32): 1500 lb.
   c. Heavy (MSS Type 33): 3000 lb.

13. 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.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
   2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
   3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
   2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
   3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
   4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
   5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
   6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
   7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
   8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
      a. Horizontal (MSS Type 54): Mounted horizontally.
      b. Vertical (MSS Type 55): Mounted vertically.
      c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 23 05 29
SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Equipment labels.
   2. Pipe labels.
   3. Valve tags.

1.03 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
C. Valve numbering scheme.
D. Valve Schedules: For each piping system to include in maintenance manuals.

1.04 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

2.01 EQUIPMENT LABELS
A. Plastic Labels for Equipment:
   1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
   4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
   5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   7. Fasteners: Stainless-steel rivets or self-tapping screws.
B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.02 PIPE LABELS
A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 incheshigh.

E. All working/color combinations shall meet ANSI A13.1 Standards.

2.03 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
   1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass beaded chain.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
   1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 EXECUTION

3.01 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.

3.02 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.03 PIPE LABEL INSTALLATION

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
   1. Near each valve and control device.
   2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
   3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
   4. At access doors, manholes, and similar access points that permit view of concealed piping.
   5. Near major equipment items and other points of origination and termination.
   6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

3.04 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
1. Valve-Tag Size and Shape:
   a. Loop Water, Heating water, Chiller Water : 1-1/2 inches,
2. Valve-Tag Color:
3. Letter Color:
   a. Loop Water, Heating water, Chilled Water : Black or Green.

END OF SECTION 23 05 53
SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
   A. Section Includes:
      1. Balancing Air Systems:
         a. Constant-volume air systems.
         b. Variable-air-volume systems.
      2. Balancing Hydronic Piping Systems:
         a. Variable-flow hydronic systems.
      3. Testing, Adjusting, and Balancing Equipment:
         a. Motors.
         b. chillers.
         c. Cooling towers.
         d. Heat-transfer coils.
      4. Control system verification.

1.03 DEFINITIONS
   C. TAB: Testing, adjusting, and balancing.
   D. TABB: Testing, Adjusting, and Balancing Bureau.
   E. TAB Specialist: An entity engaged to perform TAB Work.

1.04 INFORMATIONAL SUBMITTALS
   A. Certified TAB reports.
   B. Sample report forms.
   C. Instrument calibration reports, to include the following:
      1. Instrument type and make.
      2. Serial number.
      3. Application.
      4. Dates of use.
      5. Dates of calibration.

1.05 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.

1.06 COORDINATION
   A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
   B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.
1.07 P2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

2.01 TAB SPECIALISTS

A. Subject to compliance with requirements, engage one of the following:
   1. Systems Management Company, Des Moines, Iowa
   2. Johnson Service of Des Moines, IA
   3. Precision Test & Balance
   4. Integrity Test & Balance

B. PERSONNEL
   1. All personnel involved in the execution of the balancing and testing work shall be regular employees of the Testing and Balancing Agency, experienced and trained in the total balancing of mechanical systems.

2.02 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine equipment performance data including fan curves.
   1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
   2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

E. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

F. Examine test reports specified in individual system and equipment Sections.

G. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

H. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

I. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

J. Examine control valves for proper installation for their intended function of diverting or mixing fluid flows.

K. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

L. Examine system pumps to ensure absence of entrained air in the suction piping.

M. Examine operating safety interlocks and controls on HVAC equipment.

N. 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.

2.03 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:
1. Air side:
   a. Permanent electrical-power wiring is complete.
   b. Hydronic systems are filled, clean, and free of air.
   c. Automatic temperature-control systems are operational.
   d. Equipment and duct access doors are securely closed.
   e. Balance dampers are open.
   f. Isolating and balancing valves are open and control valves are operational.
   g. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
   h. Windows and doors can be closed so indicated conditions for system operations can be met.
   i. Suitable access to balancing devices and equipment is provided.

2. Hydronics:
   a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
   b. Piping is complete with terminals installed.
   c. Water treatment is complete.
   d. Systems are flushed, filled, and air purged.
   e. Strainers are pulled and cleaned.
   f. Control valves are functioning per the sequence of operation.
   g. Shutoff and balance valves have been verified to be 100 percent open.
   h. Pumps are started and proper rotation is verified.
   i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
   j. Variable-frequency controllers' startup is complete and safeties are verified.
   k. Suitable access to balancing devices and equipment is provided.

2.04 GENERAL PROCEDURES FOR TESTING AND BALANCING
   A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
   B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
      1. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."
   C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
   D. Take and report testing and balancing measurements in inch-pound (IP) units.

2.05 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS
   A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
   B. Prepare schematic diagrams of systems' "as-built" duct layouts.
   C. For variable-air-volume systems, develop a plan to simulate diversity.
   D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
   E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
   F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
   G. Verify that motor starters are equipped with properly sized thermal protection.
H. Check dampers for proper position to achieve desired airflow path.
I. Check for airflow blockages.
J. Check condensate drains for proper connections and functioning.
K. Check for proper sealing of air-handling-unit components.
L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

2.06 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:
   1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
   2. Verify that the system is under static pressure control.
   3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer’s recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
   4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:
      a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
      b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
      c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
      d. Adjust controls so that terminal is calling for minimum airflow.
      e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
      f. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.
   5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
      a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
      b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
      c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
      d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
      e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
   6. Measure fan static pressures as follows:
      a. Measure static pressure directly at the fan outlet or through the flexible connection.
      b. Measure static pressure directly at the fan inlet or through the flexible connection.
      c. Measure static pressure across each component that makes up the air-handling system.
      d. Report any artificial loading of filters at the time static pressures are measured.
   7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
b. Verify that terminal units are meeting design airflow under system maximum flow.

8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls contractor.

9. Verify final system conditions as follows:
   a. Re-measure and confirm that return, and relief airflows are within design. Readjust to match design if necessary.
   b. Re-measure and confirm that total airflow is within design.
   c. Re-measure final fan operating data, rpms, volts, amps, and static profile.
   d. Mark final settings.
   e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
   f. Verify tracking between supply and return fans.

2.07 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
   1. Measure total airflow.
   2. Measure fan static pressures as follows to determine actual static pressure:
      a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
      b. Measure static pressure directly at the fan outlet or through the flexible connection.
      c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
      d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
   3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
      a. Report the cleanliness status of filters and the time static pressures are measured.
   4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
   5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
   6. Obtain approval from Owner for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
   7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
   1. Measure airflow of submain and branch ducts.
   2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
   3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.
D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
   1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
   2. Adjust patterns of adjustable outlets for proper distribution without drafts.

2.08 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS
A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
B. Prepare schematic diagrams of systems' "as-built" piping layouts.
C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
   1. Open all manual valves for maximum flow.
   2. Check liquid level in expansion tank.
   3. Check makeup water-station pressure gage for adequate pressure for highest vent.
   4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
   5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
   6. Set system controls so automatic valves are wide open to heat exchangers.
   7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
   8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

2.09 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS
A. Adjust pumps to deliver total design gpm.
   1. Measure total water flow.
      a. Position valves for full flow through coils.
      b. Measure flow by main flow meter, if installed.
      c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.
   2. Measure pump TDH as follows:
      a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
      b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
      c. Convert pressure to head and correct for differences in gage heights.
      d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
      e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.
B. Adjust flow-measuring devices installed in mains and branches to design water flows.
   1. Measure flow in main and branch pipes.
   2. Adjust main and branch balance valves for design flow.
   3. Re-measure each main and branch after all have been adjusted.
C. Adjust flow-measuring devices installed at terminals for each space to design water flows.
   1. Measure flow at terminals.
   2. Adjust each terminal to design flow.
3. Re-measure each terminal after it is adjusted.
4. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
5. Perform temperature tests after flows have been balanced.

D. For systems with pressure-independent valves at terminals:
   1. Measure differential pressure and verify that it is within manufacturer's specified range.
   2. Perform temperature tests after flows have been verified.

E. For systems without pressure-independent valves or flow-measuring devices at terminals:
   1. Measure and balance coils by either coil pressure drop or temperature method.
   2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

F. Verify that memory stops have been set.

2.10 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS
A. Balance the primary circuit flow first.
B. Balance the secondary circuits after the primary circuits are complete.
C. Adjust pumps to deliver total design gpm.
   1. Measure total water flow.
      a. Position valves for full flow through coils.
      b. Measure flow by main flow meter, if installed.
      c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.
   2. Measure pump TDH as follows:
      a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
      b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
      c. Convert pressure to head and correct for differences in gage heights.
      d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
      e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.
D. Adjust flow-measuring devices installed in mains and branches to design water flows.
   1. Measure flow in main and branch pipes.
   2. Adjust main and branch balance valves for design flow.
   3. Re-measure each main and branch after all have been adjusted.
E. Adjust flow-measuring devices installed at terminals for each space to design water flows.
   1. Measure flow at terminals.
   2. Adjust each terminal to design flow.
   3. Re-measure each terminal after it is adjusted.
   4. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
   5. Perform temperature tests after flows have been balanced.
F. For systems with pressure-independent valves at terminals:
   1. Measure differential pressure and verify that it is within manufacturer's specified range.
   2. Perform temperature tests after flows have been verified.
G. For systems without pressure-independent valves or flow-measuring devices at terminals:
   1. Measure and balance coils by either coil pressure drop or temperature method.
   2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.
H. Verify final system conditions as follows:
1. Re-measure and confirm that total water flow is within design.
2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
3. Mark final settings.

I. Verify that memory stops have been set.

2.11 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
   1. Manufacturer's name, model number, and serial number.
   4. Efficiency rating.
   5. Nameplate and measured voltage, each phase.
   6. Nameplate and measured amperage, each phase.
   7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

2.12 PROCEDURES FOR COOLING TOWERS

A. Shut off makeup water for the duration of the test, and verify that makeup and blowdown systems are fully operational after tests and before leaving the equipment. Perform the following tests and record the results:
   1. Measure condenser-water flow to each cell of the cooling tower.
   2. Measure entering- and leaving-water temperatures.
   3. Measure wet- and dry-bulb temperatures of entering air.
   4. Measure wet- and dry-bulb temperatures of leaving air.
   5. Measure condenser-water flow rate recirculating through the cooling tower.
   6. Measure cooling-tower spray pump discharge pressure.
   7. Adjust water level and feed rate of makeup water system.
   8. Measure flow through bypass.

2.13 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each refrigerant coil:
   1. Dry-bulb temperature of entering and leaving air.
   2. Wet-bulb temperature of entering and leaving air.
   3. Airflow.
   4. Air pressure drop.

2.14 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:
   1. Verify temperature control system is operating within the design limitations.
   2. Confirm that the sequences of operation are in compliance with Contract Documents.
   3. Verify that controllers are calibrated and function as intended.
   4. Verify that controller set points are as indicated.
   5. Verify the operation of lockout or interlock systems.
   6. Verify the operation of valve and damper actuators.
   7. Verify that controlled devices are properly installed and connected to correct controller.
   8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
   9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.
2.15 TOLERANCES
A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
   1. Equipment with Fans: Plus or minus 10 percent.
   2. Air Outlets and Inlets: Plus or minus 10 percent.
   3. Loop-Water Flow Rate: Plus or minus 10 percent.

2.16 FINAL REPORT
A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
   1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
   2. Include a list of instruments used for procedures, along with proof of calibration.
B. Final Report Contents: In addition to certified field-report data, include the following:
   1. Pump curves.
   2. Fan curves.
   3. Manufacturers' test data.
   4. Field test reports prepared by system and equipment installers.
   5. Other information relative to equipment performance; do not include Shop Drawings and product data.
C. General Report Data: In addition to form titles and entries, include the following data:
   1. Title page.
   2. Name and address of the TAB contractor.
   3. Project name.
   4. Project location.
   5. Architect's name and address.
   6. Engineer's name and address.
   7. Contractor's name and address.
   9. Signature of TAB supervisor who certifies the report.
   10. Table of Contents with the total number of pages defined for each section of the report.
       Number each page in the report.
   11. Summary of contents including the following:
       a. Indicated versus final performance.
       b. Notable characteristics of systems.
       c. Description of system operation sequence if it varies from the Contract Documents.
   12. Nomenclature sheets for each item of equipment.
   13. Notes to explain why certain final data in the body of reports vary from indicated values.
   14. Test conditions for fans performance forms including the following:
       a. Settings for exhaust-air dampers.
       b. Conditions of filters.
       c. Cooling coil, wet- and dry-bulb conditions.
       d. Fan drive settings including settings and percentage of maximum pitch diameter.
       e. Settings for supply-air, static-pressure controller.
       f. Other system operating conditions that affect performance.
D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
   1. Quantities of 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.
E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
   1. Unit Data:
      a. Unit identification.
      b. Location.
      c. Make and type.
      d. Model number and unit size.
      e. Manufacturer's serial number.
      f. Unit arrangement and class.
      g. Discharge arrangement.
      h. Sheave make, size in inches, and bore.
      i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
      j. Number, make, and size of belts.
      k. Number, type, and size of filters.
   2. Motor Data:
      a. Motor make, and frame type and size.
      b. Horsepower and rpm.
      c. Volts, phase, and hertz.
      d. Full-load amperage and service factor.
      e. Sheave make, size in inches, and bore.
      f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
   3. Test Data (Indicated and Actual Values):
      a. Total air flow rate in cfm.
      b. Total system static pressure in inches wg.
      c. Fan rpm.
      d. Discharge static pressure in inches wg.
      e. Filter static-pressure differential in inches wg.
      f. Cooling-coil static-pressure differential in inches wg.
      g. Heating-coil static-pressure differential in inches wg.
      h. Outdoor airflow in cfm.
      i. Return airflow in cfm.
      j. Outdoor-air damper position.
      k. Return-air damper position.

F. Apparatus-Coil Test Reports:
   1. Coil Data:
      a. System identification.
      b. Location.
      c. Coil type.
      d. Number of rows.
      e. Fin spacing in fins per inch o.c.
      f. Make and model number.
      g. Face area in sq. ft..
      h. Tube size in NPS.
      i. Tube and fin materials.
      j. Circuiting arrangement.
   2. Test Data (Indicated and Actual Values):
      a. Air flow rate in cfm.
      b. Average face velocity in fpm.
      c. Air pressure drop in inches wg.
      d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
      e. Return-air, wet- and dry-bulb temperatures in deg F.
      f. Entering-air, wet- and dry-bulb temperatures in deg F.
      g. Leaving-air, wet- and dry-bulb temperatures in deg F.
      h. Water flow rate in gpm.
i. Water pressure differential in feet of head or psig.

j. Entering-water temperature in deg F.

k. Leaving-water temperature in deg F.

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:
   1. Fan Data:
      a. System identification.
      b. Location.
      c. Make and type.
      d. Model number and size.
      e. Manufacturer's serial number.
      f. Arrangement and class.
      g. Sheave make, size in inches, and bore.
      h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
   2. Motor Data:
      a. Motor make, and frame type and size.
      b. Horsepower and rpm.
      c. Volts, phase, and hertz.
      d. Full-load amperage and service factor.
      e. Sheave make, size in inches, and bore.
      f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
   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.

H. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
   1. Report Data:
      a. System and air-handling-unit number.
      b. Location and zone.
      c. Traverse air temperature in deg F.
      d. Duct static pressure in inches wg.
      e. Duct size in inches.
      f. Duct area in sq. ft..
      g. Indicated air flow rate in cfm.
      h. Indicated velocity in fpm.
      i. Actual air flow rate in cfm.
      j. Actual average velocity in fpm.
      k. Barometric pressure in psig.

I. Air-Terminal-Device Reports:
   1. Unit Data:
      a. System and air-handling unit identification.
      b. Location and zone.
      c. Apparatus used for test.
      d. Area served.
      e. Make.
      f. Number from system diagram.
      g. Type and model number.
      h. Size.
      i. Effective area in sq. ft..
   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.

J. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:
   a. System and air-handling-unit identification.
   b. Location and zone.
   c. Room or riser served.
   d. Coil make and size.

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.

K. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:
   a. Unit identification.
   b. Location.
   c. Service.
   d. Make and size.
   e. Model number and serial number.
   f. Water flow rate in gpm.
   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.

L. Instrument Calibration Reports:

1. Report Data:
a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

2.17 INSPECTIONS

A. Initial Inspection:
   1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.

B. Prepare test and inspection reports.

END OF SECTION 23 05 93
PART 1 GENERAL
1.01 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary
      Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
   A. Section includes insulating the following duct services:
      1. Indoor, concealed supply and outdoor air.
      2. Indoor, exposed supply and outdoor air.
      3. Indoor, concealed return located in unconditioned space.
      4. Indoor, exposed return located in unconditioned space.
      5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
      6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
   B. Related Sections:
      1. Section 23 07 16 "HVAC Equipment Insulation."
      2. Section 23 07 19 "HVAC Piping Insulation."
      3. Section 23 31 13 "Metal Ducts" for duct liners.

1.03 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor
      permeance thickness, and jackets (both factory- and field-applied if any).

1.04 QUALITY ASSURANCE
   A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship
      program or another craft training program certified by the Department of Labor, Bureau of
      Apprenticeship and Training.
   B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing
      identical products according to ASTM E 84, by a testing agency acceptable to authorities having
      jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and
      cement material containers, with appropriate markings of applicable testing agency.
      1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index
         of 50 or less.
      2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed
         index of 150 or less.

1.05 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.

1.06 COORDINATION
   A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section
      23 05 29 "Hangers and Supports for HVAC Piping and Equipment."
   B. Coordinate clearance requirements with duct Installer for duct insulation application. Before
      preparing ductwork Shop Drawings, establish and maintain clearance requirements for
      installation of insulation and field-applied jackets and finishes and for space required for
      maintenance.
   C. Coordinate installation and testing of heat tracing.

1.07 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

2.01 INSULATION MATERIALS


B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.02 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

2.03 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
   1. Products: Subject to compliance with requirements, provide the following:

   1. Products: Subject to compliance with requirements, provide one of the following:
      b. Eagle Bridges - Marathon Industries; 225.

2.04 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
   1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
   1. Products: Subject to compliance with requirements, provide one of the following:
b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180 deg F.

4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.


C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
   1. Products: Subject to compliance with requirements, provide one of the following:
      b. Eagle Bridges - Marathon Industries; 550.
      e. Vimasco Corporation; WC-1/WC-5.

2.05 SEALANTS
A. FSK and Metal Jacket Flashing Sealants:
   1. Products: Subject to compliance with requirements, provide one of the following:
      b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
      c. Mon-Eco Industries, Inc.; 44-05.

2.06 FACTORY-APPLIED JACKETS
A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing;
      complying with ASTM C 1136, Type II.

2.07 FIELD-APPLIED FABRIC-REINFORCING MESH
A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering ducts.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 5.
    B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for ducts.
   1. Products: Subject to compliance with requirements, provide one of the following:
      b. Vimasco Corporation; Elastafab 894.

2.08 FIELD-APPLIED CLOTHS
A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..
   1. Products: Subject to compliance with requirements, provide one of the following:
2.09 TAPES

A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. ABI, Ideal Tape Division; 491 AWF FSK.
      b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
      c. Compac Corporation; 110 and 111.
      d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
   2. Width: 3 inches.
   3. Thickness: 6.5 mils.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch in width.
   7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.10 SECUREMENTS

A. Bands:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. ITW Insulation Systems; Gerrard Strapping and Seals.
      b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
   2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 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.
      a. Products: Subject to compliance with requirements, provide one of the following:
         1) AGM Industries, Inc.; CWP-1.
         2) GEMCO; CD.
         3) Midwest Fasteners, Inc.; CD.
         4) Nelson Stud Welding; TPA, TPC, and TPS.
   2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
      a. Products: Subject to compliance with requirements, provide one of the following:
         1) AGM Industries, Inc.; CHP-1.
         2) GEMCO; Cupped Head Weld Pin.
         3) Midwest Fasteners, Inc.; Cupped Head.
         4) Nelson Stud Welding; CHP.
   3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
      a. Products: Subject to compliance with requirements, provide one of the following:
         1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
         2) GEMCO; Perforated Base.
         3) Midwest Fasteners, Inc.; Spindle.
      b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
      c. Spindle: Stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
      d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) AGM Industries, Inc.; RC-150.
      2) GEMCO; R-150.
      3) Midwest Fasteners, Inc.; WA-150.
      4) Nelson Stud Welding; Speed Clips.
   b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
D. Wire: 0.062-inch soft-annealed, stainless steel.

2.11 CORNER ANGLES
A. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

PART 3 EXECUTION
3.01 EXAMINATION
A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
   1. Verify that systems to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION
A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.03 GENERAL INSTALLATION REQUIREMENTS
A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
E. Install multiple layers of insulation with longitudinal and end seams staggered.
F. Keep insulation materials dry during application and finishing.
G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
H. Install insulation with least number of joints practical.
I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
J. Apply adhesives, mastics, and sealants at manufacturer’s recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
      a. For below ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams with tape, according to insulation material manufacturer’s written instructions, to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.04 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated):
   Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
   1. Comply with requirements in Section 07 84 13 "Penetration Firestopping" and fire-resistive joint sealers.

C. Insulation Installation at Floor Penetrations:
   1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.05 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
   1. Apply adhesives according to manufacturer’s recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
   2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
   3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
      a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
      b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
      c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
      d. Do not overcompress insulation during installation.
e. Impale insulation over pins and attach speed washers.

f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.

6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
   1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
   2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
   3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
      a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
      b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
      c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
      d. Do not overcompress insulation during installation.
      e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
   4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
      a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
      b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover
 insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

7. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
8. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
9. Completely encapsulate insulation with coating, leaving no exposed insulation.
10. Draw jacket material smooth and tight.
11. Install lap or joint strips with same material as jacket.
12. Secure jacket to insulation with manufacturer's recommended adhesive.
13. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
14. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

3.06 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:
   1. Indoor, concealed supply and outdoor air.
   2. Indoor, exposed supply and outdoor air.
   3. Indoor, concealed return located in unconditioned space.
   4. Indoor, exposed return located in unconditioned space.
   5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
   6. Indoor, concealed oven and warewash exhaust.
   7. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
   8. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
   9. Flexible connections at the supply discharge of the heat pumps.

B. Items Not Insulated:
   1. Fibrous-glass ducts.
   2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
   3. Factory-insulated flexible ducts.
   5. Vibration-control devices.
   6. Factory-insulated access panels and doors.

3.07 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round and flat-oval, supply-air duct insulation shall be the following:
   1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

B. Concealed, round and flat-oval, return-air duct insulation shall be the following:
   1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

C. Concealed, round and flat-oval, outdoor-air duct insulation shall be the following:
   1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

D. Concealed, round and flat-oval, exhaust-air duct insulation shall be the following:
   1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

E. Exposed, outdoor-air plenum insulation shall be the following:

F. Exposed, exhaust-air plenum insulation shall be the following:
3.08  REFER TO DRAWINGS FOR DUCT INSULATION AND LINER SCHEDULE.

END OF SECTION 23 07 13
SECTION 23 07 19
HVAC PIPING INSULATION

PART 1 GENERAL

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

1.02 SUMMARY
A. Section includes insulating the following HVAC piping systems:
   1. Condensate drain piping, indoors.
   2. Loop-water, and Heating hot water piping, indoors
B. Related Sections:
   1. Section 23 07 13 "Duct Insulation."
   2. Section 23 07 16 "HVAC Equipment Insulation."

1.03 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.

1.04 COORDINATION
A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."
B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
C. Coordinate installation and testing of heat tracing.

PART 2 PRODUCTS

2.01 INSULATION MATERIALS
B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
E. Mineral-Fiber, Preformed Pipe Insulation:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Fibrex Insulations Inc.; Coreplus 1200.
      b. Johns Manville; Micro-Lok.
      c. Knauf Insulation; 1000-Degree Pipe Insulation.
      d. Manson Insulation Inc.; Alley-K.
      e. Owens Corning; Fiberglas Pipe Insulation.
   2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.02 INSULATING CEMENTS
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Ramco Insulation, Inc.; Super-Stik.
2.03 ADHESIVES
A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      b. Eagle Bridges - Marathon Industries; 225.
      d. Mon-Eco Industries, Inc.; 22-25.

   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      b. Eagle Bridges - Marathon Industries; 225.
      d. Mon-Eco Industries, Inc.; 22-25.

D. PVC Jacket Adhesive: Compatible with PVC jacket.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Dow Corning Corporation; 739, Dow Silicone.
      d. Speedline Corporation; Polyco VP Adhesive.
      a. Thickness: 0.016 inch sheet.
      b. Finish: Smooth.
      c. Joining: Longitudinal slip joints and 2 inch laps.
      d. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.

2.04 MASTICS
A. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      b. Vimasco Corporation; 749.
   2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 180 deg F.
   4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.

2.05 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.
B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   2. Materials shall be compatible with insulation materials, jackets, and substrates.
   3. Fire- and water-resistant, flexible, elastomeric sealant.
   4. Service Temperature Range: Minus 40 to plus 250 deg F.

2.06 FACTORY-APPLIED JACKETS
A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
   2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.07 FIELD-APPLIED JACKETS
A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Johns Manville; Zeston.
      c. Proto Corporation; LoSmoke.
      d. Speedline Corporation; SmokeSafe.
   2. Adhesive: As recommended by jacket material manufacturer.
   4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
      a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.08 TAPES
A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. ABL, Ideal Tape Division; 428 AWF ASJ.
      b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
      c. Compac Corporation; 104 and 105.
      d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
   2. Width: 3 inches.
   3. Thickness: 11.5 mils.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch in width.
   7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. ABI, Ideal Tape Division; 370 White PVC tape.
b. Compac Corporation; 130.
c. Venture Tape; 1506 CW NS.
2. Width: 2 inches.
3. Thickness: 6 mils.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

2.09 SECUREMENTS
A. Bands:
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. ITW Insulation Systems; Gerrard Strapping and Seals.
      b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
   2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
B. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.
C. Wire: 0.080-inch nickel-copper alloy.

PART 3 EXECUTION
3.01 EXAMINATION
A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
   1. Verify that systems to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.
   3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION
A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
   1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
   2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 GENERAL INSTALLATION REQUIREMENTS
A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
E. Install multiple layers of insulation with longitudinal and end seams staggered.
F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
G. Keep insulation materials dry during application and finishing.
H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
I. Install insulation with least number of joints practical.
J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
K. Apply adhesives, mastics, and sealants at manufacturer’s recommended coverage rate and wet and dry film thicknesses.
L. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
   4. For below-ambient services, apply vapor-barrier mastic over staples.
   5. Cover joints and seams with tape, according to insulation material manufacturer’s written instructions, to maintain vapor seal.
   6. 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. Handholes.
   5. Cleanouts.

3.04 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 Section 07 84 13 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

D. Insulation Installation at Floor Penetrations:
   1. Pipe: Install insulation continuously through floor penetrations.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.05 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 butt-tight 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. 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. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
   6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
   7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
   8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and
unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.

4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.06 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.

4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.

4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
   3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   4. Install insulation to flanges as specified for flange insulation application.

3.07 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:
   1. Draw jacket material smooth and tight.
   2. Install lap or joint strips with same material as jacket.
   3. Secure jacket to insulation with manufacturer's recommended adhesive.
   4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch wide joint strips at end joints.
   5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.
   1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.08 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
   1. Drainage piping located in crawl spaces.
   2. Underground piping.
   3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.09 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:
   1. All Pipe Sizes: Insulation shall be the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

B. Loop-Water Supply, Chilled Water Supply and Return and Return and heating hot water supply and return:
   1. NPS 8 and Smaller: Insulation shall be the following:

3.10 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. PVC jacket 20 mils thick shall be installed in the following areas:
   1. All exposed piping in Mechanical room and storage areas below 8'-0" above the finished floor.
   2. Provide aluminum jacketing on exterior of all chilled water piping routed outside of the building to the chiller and mechanical room on the roof.

END OF SECTION 23 07 19
SECTION 23 08 00
COMMISSIONING OF HVAC

PART 1 GENERAL

1.01 SUMMARY

A. This section covers the Contractor's responsibilities for commissioning; each subcontractor or installer responsible for the installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item.

B. The Commissioning Authority (CA) directs and coordinates all commissioning activities and provides Prefunctional Checklists and Functional Test Procedures for Contractor's use.

C. The entire HVAC system is to be commissioned, including commissioning activities for the following specific items:
   1. Control system.
   2. Major and minor equipment items.
   3. Ductwork and accessories.
   4. Terminal units.
   5. Variable frequency drives.
   6. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.

D. The Prefunctional Checklist and Functional Test requirements specified in this section are in addition to, not a substitute for, inspection or testing specified in other sections.

1.02 RELATED REQUIREMENTS

A. Section 01 78 00 - Closeout Submittals: Scope and procedures for operation and maintenance manuals and project record documents.

B. Section 01 79 00 - Demonstration and Training: Scope and procedures for Owner personnel training.

C. Section 23 09 13 - Instrumentation and Control Devices for HVAC.

D. Section 23 09 93 - Sequence of Operations for HVAC Controls.

E. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.

1.03 SUBMITTALS

A. Updated Submittals: Keep the Commissioning Authority informed of all changes to control system documentation made during programming and setup; revise and resubmit when substantial changes are made.

B. DRAFT Prefunctional Checklists and Functional Test Procedures for Control System: Detailed written plan indicating the procedures to be followed to test, checkout and adjust the control system prior to full system Functional Testing; include at least the following for each type of equipment controlled:
   1. System name.
   2. List of devices.
   3. Step-by-step procedures for testing each controller after installation, including:
      a. Process of verifying proper hardware and wiring installation.
      b. Process of downloading programs to local controllers and verifying that they are addressed correctly.
      c. Process of performing operational checks of each controlled component.
      d. Plan and process for calibrating valve and damper actuators and all sensors.
      e. Description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.
   4. Copy of proposed log and field checkout sheets to be used to document the process; include space for initial and final read values during calibration of each point and space to...
specifically indicate when a sensor or controller has “passed” and is operating within the contract parameters.

5. Description of the instrumentation required for testing.

6. Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the Commissioning Authority and TAB contractor for this determination.

C. Startup Reports, Prefunctional Checklists, and Trend Logs: Submit for approval of Commissioning Authority.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

A. Provide all standard testing equipment required to perform startup and initial checkout and required functional performance testing; unless otherwise noted such testing equipment will NOT become the property of Owner.

PART 3 EXECUTION

3.01 PREPARATION

A. Cooperate with the Commissioning Authority in development of the Prefunctional Checklists and Functional Test Procedures.

B. Furnish additional information requested by the Commissioning Authority.

C. Prepare a preliminary schedule for HVAC pipe and duct system testing, flushing and cleaning, equipment start-up and testing, adjusting, and balancing start and completion for use by the Commissioning Authority; update the schedule as appropriate.

D. Notify the Commissioning Authority when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and testing, adjusting, and balancing will occur; when commissioning activities not yet performed or not yet scheduled will delay construction notify ahead of time and be proactive in seeing that the Commissioning Authority has the scheduling information needed to efficiently execute the commissioning process.

E. Put all HVAC equipment and systems into operation and continue operation during each working day of testing, adjusting, and balancing and commissioning, as required.

3.02 INSPECTING AND TESTING - GENERAL

A. Submit startup plans, startup reports, and Prefunctional Checklists for each item of equipment or other assembly to be commissioned.

B. Perform the Functional Tests directed by the Commissioning Authority for each item of equipment or other assembly to be commissioned.

C. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.

3.03 TAB COORDINATION

A. TAB: Testing, adjusting, and balancing of HVAC.

B. Coordinate commissioning schedule with TAB schedule.

C. Review the TAB plan to determine the capabilities of the control system toward completing TAB.

D. Provide a qualified control system technician to operate the controls to assist the TAB technicians or provide sufficient training for the TAB technicians to operate the system without assistance.

3.04 CONTROL SYSTEM FUNCTIONAL TESTING

A. Prefunctional Checklists for control system components will require a signed and dated certification that all system programming is complete as required to accomplish the requirements of the Contract Documents and the detailed Sequences of Operation documentation submittal.
B. Do not start Functional Testing until all controlled components have themselves been successfully Functionally Tested in accordance with the contract documents.

C. Using a skilled technician who is familiar with this building, execute the Functional Testing of the control system as required by the Commissioning Authority.

D. Functionally Test integral or stand-alone controls in conjunction with the Functional Tests of the equipment they are attached to, including any interlocks with other equipment or systems; further testing during control system Functional Test is not required unless specifically indicated below.

E. Demonstrate the following to the Commissioning Authority during testing of controlled equipment; coordinate with commissioning of equipment.
   1. Setpoint changing features and functions.
   2. Sensor calibrations.

F. Demonstrate to the Commissioning Authority:
   1. That all specified functions and features are set up, debugged and fully operable.
   2. That scheduling features are fully functional and setup, including holidays.
   3. That all graphic screens and value readouts are completed.
   4. Correct date and time setting in central computer.
   5. Global commands features.
   6. Communications to remote sites.
   7. Fire alarm interlocks and response.
   8. Fire protection and suppression systems interfaces.
   9. That points that are monitored only, having no control function, are reporting properly to the control system.
   10. All control strategies and sequences not tested during controlled equipment testing.
   11. Trend logging and graphing features that are specified.
   12. Other integrated tests specified in the contract documents
   13. That control system features that are included but not specified to be setup are actually installed.

G. If the control system, integral control components, or related equipment do not respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice, under any of the conditions, sequences, or modes tested, correct all systems, equipment, components, and software required at no additional cost to Owner.

END OF SECTION 23 08 00
SECTION 23 09 00
INSTRUMENTATION AND CONTROL FOR HVAC

GENERAL

1.01 SECTION INCLUDES

A. Provide materials, labor, and supervision necessary to furnish and install a Direct Digital Control (DDC) system. The DDC system herein specified shall be fully integrated and installed as a complete package by the Direct Digital Control Manufacturer, and shall be completely independent of any control system currently in use as related Ankeny CSD. The system shall include all computer software and hardware, operator input/output devices, automation sensors and controls, wiring, piping, installation, supervision and labor, calibration, adjustments, testing and commissioning necessary for a complete and fully operational system.

B. The temperature controls package to be installed under this project shall be capable of full functionality as a standalone installation. For example but not limited to, in the event the supervisory platform is disabled, all local control loops shall continue to function in either their occupied or unoccupied mode. Note the requirement for standalone operation is also referenced elsewhere in this Section is consistent with past projects.

1. The TCC shall be responsible to:
   a. Provide all aspects of this Section unless specifically noted.
   b. Implement District standards regarding naming convention into point lists, objects, etc.
   c. Completely commission the DDC system installed under this project.
   d. Support the integration by way of ensuring points and objects shall be tested for read and read/write capabilities.
   e. Provide one open licensed full featured programming software for owner’s use in programming controllers provided by the TCC.
   f. Provide a local supervisor, Ethernet based, controller(s) consisting of a database of connected I/O to the head end using FOX - Niagara Native Protocol or BACnet IP. Subordinate I/O controllers shall speak open protocol BACnet IP or MS/TP.

C. General Description:
   1. The DDC control system shall include all points described and/or indicated in this project and shall be capable of point expansion in the future; future expansion shall not be limited to less than 1000 additional points of control. The DDC system components shall be BACnet BTL certified, utilizing an operator workstation at the LAN (local IP at building) level; this LAN shall be sufficient to operate this building’s systems as standalone. All components on IP subnets (field busses) shall support MS/TP architecture, with full functionality and communication both with and without the building controller. Each controller shall be capable of full and complete standalone operation of respective unit.

D. Project-Specific Requirements
   1. All hardware, equipment and material shall be completely installed two (2) weeks prior to Substantial Completion, to allow immediate start by the temperature controls contractor (TCC) as identified directly below.
   2. Upon reaching the a contractual dates of Substantial Completion (see Section 01 11 00), the TCC shall provide two (2) technical representatives for full-time onsite controls work dedicated to, and with primary responsibility for, programming and commissioning this project. This duration of onsite effort shall continue uninterrupted until the system is completely implemented and commissioned, AND acknowledged as such by the Owner’s final approval and acceptance of the system. This effort and duration is not contingent upon the project actually reaching Substantial Completion by this date, but these activities shall commence on this date. The TCC shall first propose the two representatives for Owner consideration and will be contingent upon Owner approval.

1.02 QUALIFICATIONS

A. The temperature controls contractor shall be registered with the Iowa Department of Administrative Services as a Building Automation Products and Services provider.
B. The control system shall meet specifications and qualifications as described. The controls contractor shall have a minimum of five years’ experience associated with the systems of this project, and other systems as required by the sequence of operations.

C. The temperature controls system for this project is an upgrade of the existing Johnson Controls systems by Johnson Controls and is not open to other vendors.

D. All work is to be installed by a qualified person skilled in the installation of electronic automatic control systems. The control contractor is responsible for the proper installation of the control system.
   1. The Installer shall have an established working relationship with the Control System Manufacturer of not less than three years.
   2. The installer shall have a service office within 50 miles of the project site and provide 24-hour response in the event of a customer call.

E. The contractor may elect to subcontract the installation of the electronic control system but will be responsible in total as outlined above.

F. All products used in this installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of 2 years. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner's representative in writing prior to bid date. Spare and replacement parts shall be available for at least 10 years after completion of this contract.

1.03 WORK BY OTHERS

A. The following incidental work shall be furnished by the Mechanical Contractor under the supervision of this Contractor.
   1. Install automatic valves and separable wells.
   2. Furnish and install all necessary valves, pressure taps, flow meters, water, drain and overflow connections and piping.
   3. Furnish and install all necessary piping connections required for flow devices, valve position indicators, etc.
   4. Install all automatic dampers and minimum outdoor air stations, airflow stations.
   5. Provide necessary blank-off plates (safing) required to install dampers that are smaller than duct size.
   6. Assemble multiple section dampers with required interconnecting linkages and extend required number of shafts through duct for external mounting of damper motors.
   7. Provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation and affix and seal permanently in place only after stratification problem has been eliminated.
   8. Provide access door or other approved means of access through ducts for service to control equipment.

B. The TCC shall provide a technical representative to accompany the testing and balancing contractor whenever the latter is onsite, to ensure availability of complete controls manipulation is provided to the TAB contractor. Review Section 01 11 00 Summary Of Work for schedule of contractor-access to the building during in-session periods for controls commissioning (including testing and calibration) and testing and balancing of all systems.

C. Coordination with Other Trades: Coordinate the work of this Section with that of other trades to ensure the work will be carried out in an orderly manner. The TCC shall examine the contract documents for possible conflicts between the work of this Section and that of other trades in equipment locations; pipe, duct and conduit runs; electrical outlets, equipment and fixtures; diffusers; structural and architectural features.

1.04 DESCRIPTION

A. Direct Digital Control (DDC) technology shall be used to provide the functions necessary for control of mechanical systems on this project. Specifically, FOX from Niagara, BACnet IP and BACnet MS/TP shall be fully implemented within the DDC system installed. All references to
BACnet, BACnet Testing Laboratory (BTL), etc. shall be as defined by ASHRAE Standard 135-2004.

B. The control system shall accommodate simultaneous multiple user operation. Access to the control system data should be limited only by operator password. Multiple users shall have access to all valid system data. An operator shall be able to log onto any workstation on the control system and have access to all data appropriate to the assigned level of password security.

C. The control system shall be designed such that each mechanical system will be able to operate under stand-alone control. As such, in the event of a network communication failure, or the loss of any other controller, the control system shall continue to independently operate under control.

D. Communication between the control panels and all workstations shall be over a high-speed network. All nodes on this network shall be peers. The operator shall not have to know the panel identifier or location to view or control an object. Application Specific Controllers shall be constantly scanned by the network controllers to update point information and alarm information.

E. A hierarchical topology is required to ensure acceptable response times and to manage the flow and sharing of data without unduly burdening the owner’s Ethernet/intranet.
   1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed five (5) seconds for local network-connected user interfaces.
   2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed sixty (60) seconds for remotely connected user interfaces.

F. The documentation is schematic in nature. The Contractor shall provide hardware and software necessary to implement the functions and sequences necessary to deliver the systems as intended.

G. Global commands. The Owner shall have full command of all sensor dead-bands, to allow discretionary over-ride from the District’s central operator workstation.

H. Each mechanical unit identified to be controlled through the BAS shall be provided a dedicated controller, to ensure all points associated with that unit reside under that controllers’ specific identifier. The following exceptions apply: shared controllers may be acceptable if serving similar, non-intelligent, non-programmable equipment (exhaust fans) and only when the indicated equipment points can completely reside together. The intent is to prevent scattering of points, ungrouped and/or separated between unrelated controllers.

I. System architecture shall provide secure Web access using Microsoft Internet Explorer from any computer on the owner’s LAN.

1.05 SUBMITTALS

A. TCC shall provide shop drawings and manufacturers’ standard specification data sheets on all hardware and software to be provided. No work may begin on any segment of this project until submittals have been reviewed and approved by the Engineer and Owner for conformity with the plan and specifications. All shop drawings shall be done on AutoCAD no older than version 2014 or Microsoft Visio, and provided to the Engineer for review and to the Owner on CD.

B. Quantities of items submitted shall be reviewed by the Engineer and Owner. Such review shall not relieve the contractor from providing the quantities required for completion.

C. Provide the Engineer and Owner, any additional information or data which is deemed necessary to determine compliance with these specifications or which is deemed valuable in documenting the system to be installed.
   1. The TCC shall cross-review equipment submittals for consistency, and if any items are not consistent, shall resolve such discrepancies prior to submitting to the Contractor. Include with submittals of this Section, a written statement signifying all issues relating heat pumps and controls have been fully and completely coordinated to ensure full and complete operation per the contract documents.
2. Submittal will be considered incomplete and subject to rejection without the written statement as specified above.

D. TCC to submit the following within 30 days of contract award:
1. A complete bill of materials of equipment to be used indicating quantity, manufacturer and model number.
2. A schedule of all control valves including the valve size, model number (including pattern and connections), flow, CV, pressure rating, and location.
3. Provide manufacturer's cut sheets for major system components. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is being submitted to cover. Include:
   a. Supervisor controller(s) speaking FOX or BACnet IP protocol. The supervisor controller(s) shall also be equipped with Modbus, oBIX, LON, and SNMP protocols.
   b. Building Controllers (B-BC), Application Advanced Controllers (B-AAC) and Application Specific Controllers (B-ASC).
   c. Auxiliary Control Devices
   d. Proposed control system riser diagram showing system configuration, device locations, addresses, and cabling.
   e. Detailed termination drawings showing all required field and factory terminations. All terminal numbers shall be clearly labeled.
   f. Points list showing all system objects, and the proposed English language object names for Owner review and revision. Each piece of equipment shall be referenced by using respective Tag or Plan Mark consistent with equipment schedules.
   g. Sequence of operations for each system under control. This sequence shall be specific for the use of the Control System being provided for this project.
   h. Provide a BACnet Product Implementation Conformance Statement (PICS) for each BACnet device type in the submittal.
   i. Include a trunk cable schematic diagram depicting control panel locations and a description of the communication type, media and protocol.
   j. Complete BACnet points list identifying point names complying with District standards and which points will be read only versus read / write.
   k. Time of day schedules must be BACnet or FOX points with read / write capability.
4. The following details shall be provided in submittals for each BACnet device:
   a. Per ANSI/ASHRAE Standard 135-2004:

<table>
<thead>
<tr>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object Identifier</td>
<td>12.11.1</td>
</tr>
<tr>
<td>Object Name</td>
<td>12.11.2</td>
</tr>
<tr>
<td>Location</td>
<td>12.11.10</td>
</tr>
<tr>
<td>Device Address Binding</td>
<td>12.11.33</td>
</tr>
</tbody>
</table>

b. Area Served / Room Number
c. Location of EOL Resistors (where applicable)
d. Enumeration tables (where applicable)
e. Provide a list of BACnet points as programed within each controller indicating binary value object numbers for each optimal start / stop point and occupancy points. These points shall be shown as part of the network riser diagram.
E. Project Record Documents: Upon completion of installation submit (3) copies of record (as-built) documents. The documents shall be submitted for approval prior to final completion and include:

1. Project Record Drawings - These shall be as-built (or as-constructed or as-installed) versions of the submittal shop drawings. One set of magnetic media including CAD .DWG drawing files shall also be provided.
   a. Identify on drawings locations of all remote and/or concealed equipment.

2. Operating and Maintenance (O & M) Manual - These shall be as-built versions of the submittal product data. In addition to that required for the submittals, the O & M manual shall include:
   a. Names, address and 24-hour telephone numbers of Contractors installing equipment, and the control systems and service representative of each.
   b. Operators Manual with procedures of operating the control systems including logging on/off, alarm handling, producing point reports, trending data, overriding computer control, and changing set points and other variables.
   c. Programming Manual with a description of the programming language including syntax, statement descriptions including algorithms and calculations used, point database creation and modification, program creation and modification, and use of the editor.
   d. Engineering, Installation and Maintenance Manual(s) that explains how to design and install new points, panels, and other hardware; preventative maintenance and calibration procedures; how to debug hardware problems; and how to repair or replace hardware.
   e. A listing and documentation of all custom software created using the programming language including the point database. One set of magnetic media containing files of the software and database shall also be provided
   f. A list of recommended spare parts with part numbers and supplier.
   g. Complete original issue documentation, installation and maintenance information for all third party hardware provided including computer equipment and sensors.
   h. Complete original issue DVD set for all software provided including operating systems, programming language and operator workstation software. DVD’s shall be 4.7 GB minimum, read-only to prevent overwrite. Each disk and case shall be identified as to project/phase and date; any changes to software shall be followed with backup using additional DVD’s.
   i. Licenses, Guarantee, and Warrantee documents for all equipment and systems.
   j. Recommended preventive maintenance procedures for all system components including a schedule of tasks (inspection, cleaning, calibration, etc.), time between tasks, and task descriptions.

F. Training Manuals: The Contractor shall provide a course outline and training manuals for all training classes at least six weeks prior to the first class. The Owner reserves the right to modify any or all of the training course outline and training materials. Review and approval by Owner and Engineer shall be completed at least 3 weeks prior to first class.

1.06 CODES &STANDARDS

A. Input/output devices, specified or future, associated with the DDC control system shall be ASCII (American Standard Code for Information Interchange) coded with standard EIA (Electronic Industries Association) interface hardware.

B. Wiring performed by the TCC Contractor shall be installed in accordance with all applicable local, state, and national codes, and comply with requirements specified within Division 26.

C. Instrumentation hardware shall be supplied to directly interface with Instrument Society of America (ISA) Standards.

E. Meet requirements of all applicable standards and codes, except when more detailed or stringent requirements are indicated by the Contract Documents, including requirements of this Section.
   1. Underwriters Laboratories: Products shall be UL-916-PAZX listed.
   3. Federal Communications Commission - Part J.

F. OPEN NIC STATEMENTS - All Niagara AX software licenses shall have the following NiCS:
   "accept.station.in=*"; "accept.station.out=*"; and "accept.wb.in=" and "accept.wb.out=". All
   open NIC statements shall comply with Niagara Open NIC specifications.

1.07 WARRANTY
A. Labor & materials for control system specified shall be warranted free from defects for a period
   of twenty four (24) months after final completion acceptance by the Owner, or as described
   within Article 12 of Document 00800 Supplementary Conditions, whichever is longer. Control
   System failures during the warranty period shall be adjusted, repaired, or replaced at no charge
   or reduction in service to the Owner. The Contractor shall respond to the Owner's request for
   warranty service within 24 hours during customary business hours.

B. At the end of the final start-up/testing, when equipment and systems are operating satisfactorily
   to the Owner and Engineer, the Owner shall sign certificates certifying that the control system's
   operation has been tested and accepted in accordance with the terms of this specification. The
   date of Owner's acceptance shall be the start of warranty.

C. Operator workstation software, project specific software, database, and firmware updates shall
   be provided to the Owner at no charge during the warranty period. Written authorization by
   Owner must, however, be granted prior to the installation of such changes.

1.08 OWNERSHIP OF PROPRIETARY MATERIAL
A. All project developed hardware, software and documentation shall become the property of the
   Owner. These include but are not limited to: Project images, Record drawings, Project
   database, project-specific controller configuration tools and application programming codes,
   with all project-related documentation.

B. The dedicated configuration tool required for controller configuration shall have the capability to
   be launched form within the applicable network management software. If the configuration
   tool(s) cannot be launched form the network management software, any software required for
   controller configuration shall be provided with sufficient license capacity to support the
   installation.

C. Provide the appropriate quantity of legal copies of all software tools, configuration tools,
   management tools and utilities used during system installation, programming and
   commissioning. All tools shall be commercially available: no closed, proprietary or unavailable
   tools will be permitted. Contractor shall turn over all tools at project close out.

1.09 SYSTEM PERFORMANCE
A. Performance Standards. The system shall conform to the following:
   1. Object Command. The maximum time between the command of a binary object by the
      operator and the reaction by the device shall be 30 seconds. Analog objects shall start to
      adjust within 30 seconds.
   2. Object Scan. All changes of state and change of analog values shall be transmitted over
      the high-speed network such that any data used or displayed at a controller or workstation
      will be current, within the prior 60 seconds.
   3. Alarm Response Time. The maximum time from when an object goes into alarm to when
      it is annunciated at the workstation shall not exceed 45 seconds.
   4. Program Execution Frequency. Custom and standard applications shall be capable of
      running as often as once every 5 seconds. The Contractor shall be responsible for
      selecting execution times consistent with the mechanical process under control.
   5. Performance. Programmable Controllers shall be able to execute DDC PID control loops
      at a selectable frequency from at least once every 5 seconds. The controller shall scan
and update the process value and output generated by this calculation at this same frequency.

6. Multiple Alarm Annunciation. All workstations on the network shall receive alarms within 5 seconds of each other.

7. Reporting Accuracy. Table 1 lists minimum acceptable reporting accuracies for all values reported by the specified system.

<table>
<thead>
<tr>
<th>Measured Variable</th>
<th>Reported Accuracy U.N.O.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space temperature</td>
<td>±2°F</td>
</tr>
<tr>
<td>Ducted air</td>
<td>±2°F</td>
</tr>
<tr>
<td>Outside air</td>
<td>±2°F</td>
</tr>
<tr>
<td>Water temperature</td>
<td>±1°F</td>
</tr>
<tr>
<td>Delta-T</td>
<td>±0.25°F</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>±5% RH</td>
</tr>
<tr>
<td>Water flow</td>
<td>±5% of full scale</td>
</tr>
<tr>
<td>Air flow (terminal)</td>
<td>±10% of reading *Note 1</td>
</tr>
<tr>
<td>Air flow (measuring stations)</td>
<td>±5% of reading</td>
</tr>
<tr>
<td>Air pressure (ducts)</td>
<td>±0.1” W.G.</td>
</tr>
<tr>
<td>Water pressure</td>
<td>±2% of full scale *Note 2</td>
</tr>
<tr>
<td>Electrical power</td>
<td>5% of reading</td>
</tr>
<tr>
<td>Carbon dioxide (co2)</td>
<td>±20 PPM</td>
</tr>
</tbody>
</table>

Note 1: 10%-100% of scale
Note 2: for both absolute and differential pressure

1.10 PRODUCTS
1.11 SUPERVISED TRAINING BY THE TCC

A. Provide eight (8) hours in of supervised training for up to ten (10) of the Owners representatives simultaneously to include system operation, programming and report generation. Training shall take place at the project site during the normal work hours of 8am to 5pm weekdays. Training shall be scheduled at the owner’s discretion, in no larger than 4-hour blocks, to be completed within one calendar year, and shall include:
   1. Explanation of drawings, operations and maintenance manuals.
   2. Walk-through of the job to locate control components.
   3. DDC custom application controllers, ASC, TEC, SAC operation and function.
   4. Operator control functions including field panel programming.
   5. Explanation of adjustment, calibration and replacement procedures.

B. Provide operator orientation to the overall operational program, equipment functions (both individually and as part of the total integrated system), commands, advisories, and appropriate operator intervention required in responding to the systems operation. An Owner's manual prepared for this project by the DDC manufacturer shall be used in addition to the instruction. Three copies of the Owner's manual shall be provided.

C. The technical training will also include adequate instruction and documentation to enable maintenance staff to trouble shoot, repair, and maintain entire system and recreate all programming without factory assistance.

D. The technical training will also include adequate instruction and documentation to allow expansion by the maintenance staff of the system in the future to interface with existing pneumatic, electric, and electronic control systems. This would include activities associated with hardware and software.

E. The owner reserves the right to have credited any instructional time (i.e. training, demonstration, orientation, testing, etc.) identified in this Section, deemed by the owner to be unnecessary or not completed. Unused time shall be credited back to the owner to the nearest quarter hour and shall be credited as future technical field service time.
1.12 COMMISSIONING OF SYSTEM
A. The Temperature Control Contractor shall verify that each analog and binary device and operator responds correctly to the signal given at the control panel by physically changing each parameter and witnessing the correct corresponding reaction. The results of this testing shall be logged in a written report and submitted to the Owner and Engineer prior to final payment.
B. The Owner's representative shall witness the commissioning of the system.
C. An independent commissioning agent will fully commission the controls system per respective specification 23 0800 ‘Commissioning of HVAC’. The TCC shall coordinate with and accommodate the requirements of the agent.
D. Upon completion of the start-up but prior to the independent commissioning, the TCC shall commission their program points to ensure all points are mapped correctly and they read / write and provide adequate update times to the Tridium Supervisor.

1.13 SYSTEM APPLICATIONS BY THE TCC
A. Each workstation shall provide operator interface and off-line storage of system information. Provide the following applications at each workstation.
1. Automatic System Database Save and Restore. Each workstation shall store on the hard disk a copy of the current database of each building controller. This database shall be updated whenever a change is made in any panel in the system. The storage of this data shall be automatic and not require operator intervention. In the event of a database loss in a building management panel, the first workstation to detect the loss shall automatically restore the database for that panel.
2. Manual Database Save and Restore. A system operator with the proper password clearance shall be able to archive the database from any system panel and store on magnetic media. The operator shall also be able to clear a panel database and manually initiate a download of a specified database to any panel in the system.
3. System Configuration. The user with proper security shall be able to add new devices, assign modems to devices, and obtain a visual riser diagram of the system. This shall allow for future system changes or additions.
4. On-Line Help. Provide a context sensitive, on line help system to assist the operator in operation and editing of the system. On line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext.
5. Security. Each operator shall be required to log on to the system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system supervisor shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operator's access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto logoff time shall be set per operator password. All system security data shall be stored in an encrypted format.
6. Alarm Processing. Any object in the system shall be configurable to alarm in and out of normal state. The operator shall be able to configure the alarm limits, warning limits, states, and reactions for each object in the system.
   a. Alarm Reactions. The operator shall be able to determine what actions, if any, are to be taken, by object (or point), during an alarm. Actions shall include logging, printing, starting programs, displaying messages, dialing out to remote stations, paging, providing audible annunciation or displaying specific system alerts. Each of these actions shall be configurable by workstation and time of day. An object in alarm that has not been acknowledged within an operator specified time period shall be re-routed to an alternate operator specified alarm receipt device.
   b. Binary Alarms. Each binary object shall be set to alarm based on the operator specified state. Provide the capability to disable alarming when the associated equipment is turned off or is being serviced.
c. Analog Alarms. Each analog object shall have both high and low alarm limits and warning limits. Alarming must be able to be automatically and manually disabled.

7. Trend Logs. The operator shall be able to define a custom trend log for any data in the system. This definition shall include interval, start-time, and stop-time. Trend intervals of 1, 5, 15, 30, and 60 minutes as well as once a shift (8 hours), once a day, once a week, and once a month shall be selectable. All trends shall start based on the hour. Each trend shall accommodate up to 64 system objects. The system operator with proper password shall be able to determine how many samples are stored in each trend. Trend data shall be sampled and stored on the Building Controller panel and be archived on the hard disk. Trend data shall be able to be viewed and printed from the operator interface software. They shall also be storable in a tab delimited ASCII format for use by other industry standard word processing and spreadsheet packages.
   a. The initial trend log setup shall give the operator a room by room option to trend log the input and output devices associated with each terminal box (VAV box). This would include, but not be limited to, space temperature, cfm, and fan operation.

8. Alarm and Event Log. The operator shall be able to view all logged system alarms and events from any location in the system. Events shall be listed chronologically. An operator with the proper security level may acknowledge and clear alarms. All that have not been cleared by the operator shall be archived to the hard disk on the workstation.

9. Object and Property Status and Control. Provide a method for the operator with proper password protection to view, and edit if applicable, the status of any object and property in the system. These statuses shall be available by menu, on screen, or through custom programs.

10. Clock Synchronization. The real time clocks in all building control panels and workstations shall be synchronized on command of an operator. The system shall also be able to automatically synchronize all system clocks, daily from any operator designated device in the system. The system shall automatically adjust for daylight savings and standard time if applicable.

11. Reports and Logs. Provide a reporting package that allows the operator to select, modify, or create reports. Each report shall be definable as to data content, format, interval, and date. Report data shall be archived on the hard disk for historical reporting. Provide the ability for the operator to obtain real time logs of designated lists of objects. Reports and logs shall be stored on the PC hard disk in a format that is readily accessible by other standard software applications including spreadsheets and word processing. Reports and logs shall be readily printed to the system printer.
   a. Custom Reports: Provide the capability for the operator to easily define any system data into a daily, weekly, monthly, or annual report. These reports shall be time and date stamped and shall contain a report title and the name of the facility.

B. Workstation Applications Editors. Each PC workstation shall support full screen editing of all system applications. Provide editors for each application at the PC workstation. The applications shall be downloadable and executed at the appropriate controller panels.

1. Programming. The language shall be English language oriented and be based on the syntax of programming languages such as BASIC. It shall allow for free form or fill-in-the-blank programming: Using simple English, all text fields associated with each specific element of data shall be programmed to provide the maximum amount of information to the operator.

2. Controller. Provide a full screen editor for each type controller and application that shall allow the operator with proper password to view and change the configuration, name, control parameters, and system set-points.

3. Scheduling. An editor for the scheduling application shall be provided at each workstation. Provide a monthly calendar for each schedule. Exception schedules and holidays shall be shown clearly on the calendar. Provide a method for allowing several related objects to follow a schedule. The advance and delay time for each object shall be adjustable from this master schedule.
a. An operator with proper password level shall be able to modify the schedule. Schedules shall be able to be easily copied between objects and/or dates.
b. Occupied/Unoccupied schedules shall be individually adjustable for each terminal unit. The user shall be able to easily change the schedule of rooms, etc. An occupied space shall automatically start the unit in normal start-up mode.

4. Equipment Coordination. Provide a full screen editor that allows equipment to be grouped for proper operation as specified in the sequence of operations.

5. Custom Application Programming. Provide the tools to create, modify, and debug custom application programming. The operator shall be able to create, edit, and download custom programs at the same time that all other system applications are operating. The system shall be fully operable while custom routines are edited, compiled, and downloaded. The programming language shall have the following features:
   a. A full screen character editor/programming environment shall be provided. The editor shall be cursor/mouse-driven and allow the user to insert, add, modify, and delete code from the custom programming. It shall also incorporate word processing features such as cut/paste and find/replace.
   b. The programming language shall allow independently executing program modules to be developed. Each module shall be able to independently enable and disable other modules.
   c. The editor/programming environment shall have a debugging/simulation capability that allows the user to step through the program and to observe any intermediate values and or results. The debugger shall also provide error messages for syntax and execution errors.
   d. The programming language shall support conditional statements (IF/THEN/ELSE/ELSE-IF) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
   e. The programming language shall support floating point arithmetic using the following operators: +, -, /, x, square root, and xy. The following mathematical functions shall also be provided: natural log, log, absolute value, and minimum/maximum value from a list of values.
   f. The programming language shall have pre-defined variables that represent clock time, day of the week, and date. Variables that provide interval timing shall also be available. The language shall allow for computations using these values.
   g. The programming language shall have ability to pre-defined variables representing the status and results of the System Software, and shall be able to enable, disable, and change the values of objects in the system.

1.14 POWER FAIL RESTART
   A. In the event of the loss of normal power, there shall be an orderly shutdown of the digital panels and workstation to prevent the loss of data base or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data, and battery backup shall be provided to support the clock and all volatile memory for a minimum of 72 hours. NOTE: Reference to ‘battery backup’ shall only apply to building controllers (B-BC); all hardware below the B-BC in the BAS architecture shall utilize non-battery means of backup.
   B. Upon restoration of normal power, the panels shall automatically resume full operation without manual intervention.
   C. Should Digital panel memory be lost for any reason, the user shall have the capability of reloading the panel via the local RS-232 port, or telephone line dial-in.

1.15 SYSTEM SOFTWARE
   A. Furnish the following applications software for building and energy management. All software applications shall reside and run in the system controllers. Editing of applications shall occur at the operator workstation.
   B. System Security
      1. User access shall be secured using individual security passwords and user names.
2. Passwords shall restrict the user to only the objects, applications, and system functions as assigned by the system manager.
3. User logon/logoff attempts shall be recorded.
4. The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user definable.

C. Graphics by the TCC. Provide complete color graphic operator/user interface to include the following graphics as a minimum:
   1. Graphic floor plans accurately depicting primary architectural features (i.e. rooms, walls, corridors, etc.). Show accurate locations of space sensors and major mechanical equipment.
   2. Detail graphics for each individual mechanical unit.
   3. Provide direct software links (hot button) on each graphic to access: system drawings, technical literature, Bill of Material and Sequence of Operation. System drawings shall be pdf format representing as-built conditions documented at time of installation.

D. Scheduling. Provide the capability to schedule each object or group of objects in the system. Each of these schedules shall include the capability for start, stop, optimal start, optimal stop, night setback, and economizer actions. Each schedule shall have capacity for up to 10 events. All Schedules shall be communicated to the Tridium supervisor using BACnet objects. When a group of objects are scheduled together, provide the capability to define advances and delays for each member. Each schedule shall consist of the following:
   1. Weekly Schedule. Provide separate schedules for each day of the week. Provide separate scheduling that is easily edited by the operator to define the occupied hours for each space.
      a. All spaces served by a heat pump shall have the option to maintain night setback temperatures or occupied temperatures.
   2. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. This exception schedule shall override the standard schedule for that day. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed it will be discarded and replaced by the standard schedule for that day of the week.
      a. Specifically label and program “snow day” to keep the building in the unoccupied mode with the option to set back the temperature or to bring it up to the occupied setpoint.
   3. Holiday Schedules. Provide the capability for the operator to define up to 99 special or holiday schedules. These schedules shall be placed on the scheduling calendar and will be repeated each year. The operator shall be able to define the length of each holiday period.
   4. Optimal Start/Stop. The TCC will create an “Optimal Start” program/schedule, in addition to an Occupied program/schedule for all HVAC equipment with outdoor air capability. Note: control of start/stop is required for each fan in multi-fan equipment. The OSS schedule shall be communicated to the Tridium supervisor using BACnet objects.
      a. The Optimal Start program is used primarily during the morning warm up period but may be scheduled at several other times of day. When the program is enabled it should adjust the unoccupied temperature setpoint (either heating or cooling) to the occupied setpoint (73° heating, 75° cooling) with a differential of 1°. The program will allow the supply fan to run only on a call for heating or cooling. Outside air dampers will remain closed during the Optimal Start mode. When the program is disabled, it should adjust the unoccupied setpoint (60° heating, 95° cooling) with a differential of 6°. All set points shall be adjustable. The set points should be programmed as follows:

<table>
<thead>
<tr>
<th>OpSt Enabled - Fan On</th>
<th>Heating</th>
<th>Cooling</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>73°</td>
<td>75°</td>
</tr>
<tr>
<td>OpSt Enabled - Fan Off</td>
<td>72°</td>
<td>76°</td>
</tr>
</tbody>
</table>
E. Alarm Reporting (by TCC). The operator shall be able to determine the action to be taken in the event of an alarm. Alarms shall be routed to the appropriate workstations based on time and other conditions. An alarm shall be able to start programs, be logged in the event log, printed and generate custom messages. The TCC shall translate any 3rd party integration alarm points to the Tridium supervisor utilizing Ankeny CSD's standard point naming convention. Communication to the supervisor shall be accomplished by BACnet or FOX objects.

1. Each alarm shall provide the following data:
   a. Time & date.
   b. Location (building, floor, zone, office number, etc.).
   c. Specific equipment (equipment tag, access way, etc.) and associated equipment (i.e. heat pump under alarm).
   d. Acknowledge time, date and user who issued acknowledgement.
   e. Number of occurrences since last acknowledgement.

2. Provide a 'query' feature to allow review of specific alarms by user-defined parameters.

3. Provide a separate log for system alerts (self-populating) for review by the user.

4. Controller and network failures shall be treated as alarms and annunciated.

5. System shall be capable of distributing alarms with complete message and interface with multiple recipients by email, cell phone or pagers via the owner's email service. Provide the ability to route and email alarms based on: day of week, time of day and recipient.

F. Remote Communications. The system shall have the ability to dial out in the event of an alarm. Receivers shall include PC Workstations and the owner's email system. The alarm message shall include the name of the calling location, the device that generated the alarm, and the alarm message itself. The operator shall be able to remotely access and operate the system using dial up communications.

1.16 BUILDING CONTROLLERS

A. General. Provide FOX, Niagara 4 or BACnet IP Building Controllers to provide the performance specified in this section. The supervisor controller(s) shall also be equipped with Modbus, oBIX, LON, and SNMP protocols. Subordinate serial, IP, devices connected to the building controller shall speak BACnet IP or MS/TP. 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 a Portable Operators Terminal.

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. Data shall be shared between networked Building Controllers.

6. 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.

7. Total memory shall be a minimum 4GB per supervisor controller. The data storage shall be through a solid state hard drive, no mechanical hard drives will be accepted.

8. At least one Ethernet port with GB (Gigabyte) data transfer.
B. 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 32° F to 120° F.

C. 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.

D. Memory. The Building Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.

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 shut-down below 80% nominal voltage.

F. All building level controllers must be able of communicating FOX or BACnet IP and BACnet ms/tp which includes communicating of all appropriate BACnet objects such as point names, schedules, alarm designators, etc.

1.17 CUSTOM OR ADVANCED APPLICATION CONTROLLERS

A. General. Provide BACnet Advanced Application Controllers (B-AAC) to provide the performance specified in this specification. 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 local strategies described in System software section.

2. The Controller shall have sufficient memory to support its operating system, database, and programming requirements.

3. 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.

4. Data shall be shared between networked Controllers.

5. The 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.

B. Environment. Controller hardware shall be suitable for the anticipated ambient conditions.

1. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA Type 4 waterproof enclosures, and shall be rated for operation at -40° F to 150° F.

2. Controllers used in conditioned ambient shall be mounted in dust-proof enclosures, and shall be rated for operation at 32° F to 120° F.

C. 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.

D. Memory. The Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.

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 shut-down below 80% nominal voltage.

F. All application level controllers must be able of communicating BACnet IP or BACnet ms/tp which includes communicating of all appropriate BACnet objects such as point names, schedules, alarm designators, etc.

1.18 APPLICATION SPECIFIC CONTROLLERS

A. General. Provide BACnet Application Specific Controllers (B-ASC), 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 B-ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network.
2. Each B-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 Type 4 waterproof enclosures, and shall be rated for operation at -40° F to 150° F.
2. Controller used in conditioned ambient shall be mounted in dust-proof enclosures, and shall be rated for operation at 32° F to 120° F.

C. Serviceability. Provide diagnostic LEDs for power, and communications. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable.

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 shut-down 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. All application specific controllers must be able of communicating BACnet IP or BACnet ms/tp which includes communicating of all appropriate BACnet objects such as point names, schedules, alarm designators, etc.

1.19 COMMUNICATIONS

A. The TCC shall provide all communication media, connectors, repeaters, hubs, and routers necessary for the inter-network.

B. All Building Controllers shall have a communications port for connections with the operator interfaces.

C. Communications services over the inter-network shall result in operator interface and value passing that is transparent to the inter-network architecture as follows:
1. Connection of an operator interface device to any one controller on the inter-network 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 inter-network.
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 inter-network. 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 inter-network value passing.

D. The time clocks in all controllers shall be automatically synchronized daily.

1.20 INPUT/OUTPUT INTERFACE

A. Hard-wired inputs and outputs shall 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 or 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. 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.

1.21 AUXILIARY CONTROL DEVICES

A. Devices, components and hardware, either specified or required to control the mechanical system, shall comply with the requirements of the related Division 23 specification section.

B. Contractor limited to device manufacturers identified. Where not specified, provide component by manufacturer of choice.

C. Electronic damper/valve actuators.
   1. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator. Furnish a separate damper actuator for each damper greater than 48" in any dimension.
   2. Where shown, for power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing.
   3. All rotary spring return actuators shall be capable of both clockwise and counter clockwise spring return operation. Linear actuators shall spring return to the retracted position.
   4. Proportional actuators shall accept a 0-10 VDC or 0-20 ma control signal and provide a 2-10 VDC or 4-20 ma operating range.
   5. All 24 VAC/DC actuators shall not require more than 10 VA for AC or more than 8 W for DC applications. Actuators operating on 120 VAC or 230 VAC shall not require more than 11 VA.
   6. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb. torque capacity shall have a manual crank for this purpose.
   7. All modulating actuators shall have an external, built-in switch to allow the reversing of direction of rotation.
   8. Actuators shall be provided with a conduit fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
   9. Actuators shall be Underwriters Laboratories Standard 873 listed.
  10. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator’s rated torque. Actuators shall include a stroke limiting device.

D. Automatic Dampers (low leakage)
   1. Also refer to Section 23 33 13 Volume Control Dampers.
   2. Dampers shall include the frame, blades, and linkage assembly. Coordinate damper sizes and quantities with exhaust air fans, plenums, air handling units, and built up air handling units. Dampers shall be as follows:
      a. Opposed blade configuration and suitable for operating temperatures between -40° F and 200° F. The assembly shall provide for the linkage out of the airstream and concealed in the frame.
      b. Blade type
         1) Airfoil: As remote recirculation damper for air-air heat exchanger operation.
         2) Double piece: Typical usage.
3) The seals shall include extruded vinyl blade edge seals and flexible metal compression type jamb seals. Bearings shall be stainless steel sleeve. The axles shall be 1/2" plated steel hex.

4) The Damper shall be constructed of a minimum of 16 gauge galvanized steel.

5) Damper shall have a maximum leakage performance rating of 4 cfm per square foot at 1 inch water gauge static pressure differential (based on a 36 "wide x 24" high damper).

6) Dampers shall bear the AMCA certification for air leakage.

7) Low leakage dampers shall be by Ruskin or approved equal.

3. Reference the drawings for minimum and economizer outdoor air damper sizes.

4. Submit product data, performance and installation data. Clearly indicate profile of damper size, materials, damper blade configuration, damper linkage, leakage characteristics and operators.

5. General
   a. Dampers shall fail normally open, closed or last position as scheduled on plans or as follows:
      1) VHP’s outdoor air & exhaust/relief - normally closed.
      2) VHP’s supply & return - normally open.
      3) Motorized dampers in ventilation supply ductwork - last position.
      4) Other applications - by inherent operation or as required by sequence of operation.

E. Control Valves
   1. Provide each mechanical hydronic unit with a dedicated automatic control valve. Valves shall be two-way or three-way, two position or modulating, as scheduled or indicated in the sequence of operation, all of which apply to piping bypasses. Each major run of piping (serving more than three mechanical units) shall be provided a valved bypass; each valved bypass shall be controlled by a dedicated differential pressure sensor.

2. Control valves shall be two-way or three-way type for two-position or modulating service as scheduled, shown, or as indicated in the sequence of operation.

3. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
   a. Water Valves:
      1) Two-way: 150% of total system (pump) head.
      2) Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.

4. Water Valves:
   a. Body and trim style and materials shall be per manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service.
   b. Sizing Criteria:
      1) Two-position service: Line size.
      2) Modulating Service: Pressure drop equal to the pressure drop through the coil exchanger (load), 3 psi maximum. End-of-line valves at bypass shall be line size.
      3) Valves 1/2" through 2" shall be bronze body or cast brass ANSI Class 250, spring loaded, Teflon packing, quick opening for two-position service. Two-way valves to have replaceable composition disc, or stainless steel ball.
      4) 2-1/2" valves and larger shall be cast iron ANSI Class 125 with guided plug and Teflon packing.

5. General
   a. Water valves shall fail normally open or closed as scheduled on plans or as follows:
      1) VHP’s - normally open.
      2) 2-way heat pump control valves - normally open.
      3) 3-way end-of-line control valves - fail at last position.
      4) Other applications - by inherent operation or as required by sequence of operation.
F. Sensors:
   1. Room and duct humidity sensors shall be of the thin film capacitance type containing a humidity sensitive material that modifies its dielectric constant to maintain accuracy of +5% RH @ 77° F, range of 20% to 95% RH, including hysteresis, linearity, and repeatability. The sensor shall be rated for operation between 15 to 170 degrees F.
   2. All temperature and humidity sensors shall be of the electronic type. The temperature sensors shall be resistance temperature device (RTD) or thermistor type.
      a. Room sensors shall include covers for horizontal or vertical mounting and concealed adjustments. Sensors shall include adjustable slide temperature sensors, and two-hour push button override. All wall sensors located on exterior walls or surfaces that will cause abnormal sensor readings shall be furnished with an insulated base.
      b. Room sensors shall have a range of 32-120 degrees F with a factory calibration of 74° F. Accuracy shall be plus or minus 1 degree F at calibration point. Mounting height of room sensors shall be verified with owner prior to installation.
      c. Sensors located in areas of common areas (i.e. high density occupancy, gathering spaces and/or foot traffic) shall be provided with high impact plastic guards, including but not limited to corridors, IMC/library, cafeteria, commons, athletic spaces, mechanical-electrical-utility spaces. Covers shall be Grainger model 2E379 or equivalent.
      d. Mounting: typical space sensors at 48" above floor to center; sensors in common areas at 96" above floor to center.
      e. Duct Temperature Sensors - accuracy of +1° F @ 77 deg F. Duct air sensors shall be duct single point, averaging probe or averaging bulb as required under sequence of operation. Use insertion elements with a brass well with a minimum length of 2.5".
      f. Outside air sensor shall have watertight inlet fitting and contain a shield from direct sunlight.

G. Differential Pressure Switch (static) - shall sense static differential pressure for negative application (exhaust air duct), positive pressure (supply duct), or a differential pressure switch (filters) and shall be automatic reset type with an adjustable range from .05-12" WC.

H. Low Temperature Detection
   1. Electric low temperature warning thermostats shall have 20 ft low point sensitive elements (not averaging type) installed in parallel or series to serpentine the entire coil face area of the chilled water coil. These thermostats shall be two-position reset type. Where coils are in banks, multiple low limit thermostats, wired in series, shall be provided and wired to initiate the freeze condition sequences specified and signal a remote alarm to the facilities management console.
   2. The low temperature thermostat shall be automatic reset type as described in the sequence of operations.
   3. Thermostat shall be adjustable between the temperatures of 35° to 45° F.

I. Current Sensing Relays - shall be split core type with adjustable high and low trip settings. Range shall not exceed 175% of expected input. Coordinate special requirements for systems with variable speed drives. Relays shall be the Hawkeye series by Veris Industries.

J. Flow Switches
   1. Flow-proving switches shall be differential pressure type for proof of flow application.
   2. Differential pressure type switches (air or water service) shall be UL listed, solid state, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA Type 1 enclosure, with scale range and differential suitable for intended application, or as specified. Mercoid type switches shall not be used for equipment that vibrates such as chillers, etc. Differential pressure switches shall be by Orange Research or approved equal.
   3. Current sensing relays may be used for flow sensing or terminal devices.

K. Relays
   1. Control relays shall be UL listed plug-in type with dust cover. Contact rating, configuration, and coil voltage suitable for application.
2. Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable plus or minus 200% (minimum) from set-point shown on plans. Contact rating, configuration, and coil voltage suitable for application. Provide NEMA Type 1 enclosure when not installed in local control panel.

L. Transformers and Power Supplies
1. Control transformers shall be UL listed, Class 2 current-limiting type, or shall be furnished with over-current protection in both primary and secondary circuits for Class 2 service.
2. Unit output shall match the required output current and voltage requirements. Current output shall allow for a 50% safety factor. Output ripple shall be 3.0 mV maximum Peak-to-Peak. Regulation shall be 0.10% line and load combined, with 50 microsecond response time for 50% load changes. Unit shall have built-in over-voltage protection.
3. Unit shall operate between 0° C and 50° C.
4. Unit shall be UL recognized.

M. Local Control Panels
1. All indoor control cabinets shall be fully enclosed NEMA Type 1 construction with hinged door, key-lock latch, and removable sub-panels. A single key shall be common to all field panels and sub-panels.
2. Interconnections between internal and face-mounted devices pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600-volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.
3. Provide engraved phenolic nameplates identifying all internal devices, mounted on the face of each panel. Provide a complete set of as-built control drawings related to the controls within the panel and placed within each control panel; panel shall be sized to easily accommodate drawings internally.

N. Auxiliary Devices
1. Furnish and install all necessary auxiliary electronic devices as appropriate to accomplish the sequence as specified. These totally electronic devices shall include (but not be limited to) such items as load-limiting controllers, low signal selectors, high signal selectors, remote reset control devices, floating alarm units, staging networks, damper position indicators, unison amplifiers, reversing networks, sequencing networks and electronic power supplies.

O. Duct Smoke Detectors
1. Duct detectors shall be furnished and installed by the electrical contractor.
2. Detectors shall be hard-wired to shutdown equipment; shutdown via BAS or programming is not acceptable.
3. Once the detector signal is cleared, the respective unit(s) shall restart automatically.

P. Variable Frequency Drives
1. Shall be furnished by and installed by the electrical contractor. Drives shall comply with Section 23 29 23 Adjustable Speed Drives.
2. The TCC and TAB contractors shall coordinate calibration of VFD’s to set minimum and maximum operating values and ensure those values are sustained when operating VFD’s ‘In hand’.

1.22 WIRING
A. All electric wiring required for the control system and any interlock wiring required for the controls sequence shall be provided by the Temperature Control Contractor.
B. All inaccessible line and low voltage control wiring (i.e. concealed, including wiring routed within walls and above gypsum ceilings) shall be run in conduit. Reference Division 26 for requirements.
C. All accessible low voltage control wiring (i.e. drop ceilings) can be run exposed using plenum rated cabling. All cabling shall be installed parallel and perpendicular to the building lines.
D. Wire shall be a minimum of #18 gauge, color-coded, stranded wire for all low voltage, electronic circuit with "spares" installed (one for every group of 10 wires) in conduit. Unconcealed wire (wire not in conduit) shall be the specific product of the TCC, with unique identifiers of the TCC manufacturer-marked on wire minimum 2 feet on center; field applied labels or flags are not acceptable. Submit samples with shop drawings for review.

E. Provide for the requirements for 120V circuits for the ASC's as necessary. All control transformers shall be the responsibility of this contractor. Reference the electrical drawings for circuit locations - if not shown on electrical plans, the TCC shall provide all required power for a fully functioning control system.

PART 3 EXECUTION

2.01 INSTALLATION

A. Install wiring in a neat and workmanlike manner. Wiring to finished spaces shall be routed concealed.

B. All work is to be installed by a qualified person skilled in the installation of electronic control systems. The control company representative is responsible for the proper installation of the control system and will provide supervision of the installation.

C. Wire the flow switches and other chiller control devices not factory wired. Reference the chiller specification.

D. Provide damper actuators for all automatic dampers.

E. Install terminal equipment controllers on terminal boxes and provide all necessary control wiring.

F. Install system and materials in accordance with manufacturer's instructions and roughing-in drawings, and details and drawings. Install electrical work and use electrical products complying with requirements of applicable Division 26 sections of these specifications. Mount controllers at convenient locations and heights.

G. Wiring. The term "wiring" is defined to include providing of wire, conduit and miscellaneous materials as required for mounting and connecting electric control devices.

H. Wiring System. Install complete wiring system for electric-electronic temperature controls. Conceal wiring, except in mechanical rooms and areas where other conduit and piping are exposed. Provide multi-conductor instrument harness (bundle) in place of single conductors where number of conductors can be run along common path. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly.

I. Number-code or color-code conductors, appropriately for future identification and servicing of control system.

2.02 ON-SITE TESTING

A. Provide Engineer and/or Owner approved operation and acceptance testing of the complete system. The Engineer and/or Owner will witness all tests.

B. Field Test. When installation of the system is complete, calibrate equipment and verify transmission media operation before the system is placed in line. All testing, calibrating, adjusting and final field tests shall be completed by the installer. Provide a cross-check of each control point within the system by making a comparison between the control command and the field-controlled device. Verify that all systems are operable from local controls in the specified failure mode upon panel failure or loss of power. Submit the results of functional and diagnostic tests and calibrations to the Engineer for final system acceptance.

C. Compliance Inspection Checklist. Submit in the form requested, the following items of information to the Owner's representative and Architect/Engineer for verification of compliance to the project specifications. Failure to comply with the specified information shall constitute non-performance of the contract. The contractor shall submit written justification for each item in the checklist that he is unable to comply with. The Owner's Representative and the
Architect/Engineer will initial and date the checklist to signify Contractor's compliance before acceptance of system.

1. Verify to the Owner's Representative and Architect/Engineer in letter form that supplier has in-place support facility. Letter shall show location of support facility, name and titles of technical staff, engineers, supervisors, fitters, electricians, managers and all other personnel responsible for the completion of the work on this project.

   User ___________________________ Date ________ A/E __________ Date ________

2. Manually generate an alarm at the remote DDC Controller as selected by the Architect/Engineer to demonstrate the capability of the workstation and alarm printer to receive alarms within 5 seconds.

   User ___________________________ Date ________ A/E __________ Date ________

3. Disconnect one DDC Controller from the network to demonstrate that a single device failure shall not disrupt or halt peer-to-peer communication. Panel to be disconnected shall be selected by the Architect/Engineer.

   User ___________________________ Date ________ A/E __________ Date ________

4. At a DDC Controller of the Architect/Engineer's choice, display on the portable operator's terminal:
   a. At least one temperature setpoint and at least one status condition; i.e.: on or off for a system or piece of equipment attached to the panel as well as for points at another DDC Controller on the network.
   b. The diagnostic results as specified for a system or piece of equipment attached to that panel as well as for a system or piece of equipment attached to another DDC Controller.
   c. The ability to add a new point to the DDC Controller with the POT and have it automatically uploaded to the workstation to modify that panel's stored database.

   User ___________________________ Date ________ A/E __________ Date ________

5. At the Architect/Engineer's choice, disconnect the trunk connection to demonstrate its lack of reliance on a DDC Controller to maintain full control functionality.

   User ___________________________ Date ________ A/E __________ Date ________

2.03 SERVICE AND GUARANTEE

A. General Requirements. Provide all services, materials and equipment necessary for the successful operation of the entire BAS System for a period of one year after completion of successful performance test. Provide necessary material required for the work. Minimize impacts on facility operations when performing scheduled adjustments and non-scheduled work.

B. Description of Work. The adjustment and repair of the system includes all computer equipment, software updates, transmission equipment and all sensors and control devices. Provide the manufacturer's required adjustment and all other work necessary.

C. Personnel. Provide qualified personnel to accomplish all work promptly and satisfactorily. Owner shall be advised in writing of the name of the designated service representative, and of any changes in personnel.
D. Schedule of Work. Provide two minor inspections at 6 month intervals and two major inspections offset equally between the minor inspections to effect quarterly inspection of alternating magnitude, and all work required as specified. Schedule major inspections in July and January. Minor inspections shall include visual checks and operational test of all equipment delivered. Major inspections shall include all work described for minor inspections and the following work:
   1. Clean all equipment, including interior and exterior surfaces.
   2. Perform signal, voltage and system isolation checks of system workstations and peripherals.
   3. Check and calibrate each field device. Check all analog points and digital points.
   4. Run all diagnostics and correct all previously diagnosed problems.
   5. Resolve and correct any previous outstanding problems.

E. Emergency Service. Owner shall initiate service calls when the system is not functioning properly. Qualified personnel shall be available to provide service to the complete system. Furnish Owner with a telephone number where service representative can be reached at all times. Service personnel shall be at the site within 4 hours after receiving a request for service. Restore the control system to proper operating condition within 24 hours.

F. Operation. Performance of scheduled adjustment and repair shall verify operation of the system as demonstrated by the initial performance test.

G. Systems Modifications. Provide any recommendations for system modification in writing to Owner. Do not make any system modifications, including operating parameters and control settings, without prior approval of Owner. Any modifications made to the system shall be incorporated into the operations and maintenance manuals, and other documentation affected.

H. Software. Provide all software updates and verify operation in the system. These updates shall be accomplished in a timely manner, fully coordinated with the system operators, and shall be incorporated into the operations and maintenance manuals, and software documentation.

2.04 EXAMINATION
   A. The project plans shall be thoroughly examined for control device and equipment locations, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.

2.05 GENERAL WORKMANSHIP
   A. Install equipment, piping, wiring/conduit parallel to building lines (i.e. horizontal, vertical, and parallel to walls) where possible.
   B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
   C. Install all equipment in readily accessible location as defined by chapter 1 article 100 part A of the NEC. Control panels shall be attached to structural walls unless mounted in equipment enclosure specifically designed for that purpose. Panels shall be mounted to allow for unobstructed access for service.
   D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
   E. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.
   F. Coordinate with the testing and balancing contractor to adjust low leakage dampers if damper leak rate exceeds specifications.

2.06 INSTALLATION OF SENSORS
   A. Install sensors in accordance with the manufacturer's recommendations.
   B. Mount sensors rigidly and adequate for the environment within which the sensor operates.
   C. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing. In retrofit locations, use shallow-depth surface mounted junction boxes.
served by Wiremold 700 dropped vertically down from the ceiling or wall penetration at structure.

D. All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor readings.

E. Install duct static pressure tap with tube end facing directly down-stream of airflow.

F. Sensors used in mixing plenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.

G. All pipe mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat conducting fluid in thermal wells.

H. Wiring for space sensors shall be concealed in building walls. EMT conduit is acceptable within mechanical and service rooms.

I. Install outdoor air temperature sensors on north wall complete with sun shield at designated location.

2.07 FLOW SWITCH AND PRESSURE DIFFERENTIAL SWITCH INSTALLATION

A. Install using a thread-o-let in steel pipe. In copper pipe use C x C x F Tee, no pipe extensions or substitutions allowed.

B. Mount a minimum of 5 pipe diameters upstream and 5 pipe diameters downstream or 2 feet whichever is greater, from fittings and other obstructions.

C. Install in accordance with manufacturer’s instructions.

D. Assure correct flow direction and alignment.

E. Mount in horizontal piping - flow switch on top of the pipe.

F. Pressure differential switches mounted on horizontal sections of pipe shall be installed on the side or top of pipes to avoid accumulation of debris.

2.08 ACTUATORS

A. Mount and link control damper actuators per manufacturer's instructions.

B. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.

C. Valves - Actuators shall be mounted on valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following manufacturer's recommendations.

2.09 WARNING LABELS

A. Affix plastic labels on each starter and equipment automatically controlled through the Control System including all air handling unit fans at doors. Label shall indicate the following:

   1. CAUTION
   2. This equipment is operating under
   3. automatic control and may start at
   4. any time without warning.

2.10 IDENTIFICATION OF HARDWARE AND WIRING

A. All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 2" of termination with a cable identifier and other descriptive information.

B. Permanently label or code each point of field terminal strips to show the instrument or item served.

C. Identify control panels with minimum 1 cm letters on laminated plastic nameplates.

D. Identify all other control components with permanent labels. Identifiers shall match record documents. All plug-in components shall be labeled such that removal of the component does not remove the label.
2.11 CONTROLLERS

A. Provide a dedicated controller (i.e. B-AAC or B-ASC) for each piece of mechanized equipment on the mechanical schedules (i.e. water-to-air heat pumps, water-to-water heat pumps, energy recovery units, etc.), and other equipment as required to provide the indicated controls; coordinate with individual equipment Sections as some controllers may be specified to be factory-installed. Points used for control loop reset such as outside air or space temperature are exempt from this requirement.

B. Building Controllers and Custom Application Controllers shall be selected to provide a minimum of 15% spare I/O point capacity for each point type found at each location. If input points are not universal, 15% of each type is required. If outputs are not universal, 15% of each type is required. A minimum of one spare is required for each type of point used.

C. Future use of spare capacity shall require providing the field device, field wiring, point database definition, and custom software. No additional Controller boards or point modules shall be required to implement use of these spare points.

D. Only like-controllers from the same manufacturer shall reside on a given buss, to prevent any negative feedback potential between dissimilar objects. The number of objects on a given buss shall not exceed the manufacturer’s recommendation, and shall be determined by the manufacturer’s conservative estimate. For example, if a controller manufacturer recommends the number of objects be limited to 32-48 objects, then work of this Section will be limited to the lower value of 32. This shall be explicitly identified in the shop drawing submittal.

2.12 PROGRAMMING

A. Provide sufficient internal memory for the specified control sequences and trend logging. There shall be a minimum of 25% of available memory free for future use.

B. Demonstration. A complete demonstration and readout of the capabilities of the monitoring and control system shall be performed. The contractor shall dedicate a minimum of 4 hours on-site with the Owner and his representatives for a complete functional demonstration of all the system requirements. This demonstration constitutes a joint acceptance inspection, and permits acceptance of the delivered system for on-line operation.

C. Software Backup
   1. Once the demonstration has been completed to the satisfaction of the Owner, provide a complete software backup of the entire building system. Where projects are to be completed in phases, also provide a copy of the building’s programmed software in existence prior to the start of the project.

2.13 CLEANING

A. This contractor shall clean up all debris resulting from his or her activities daily. The contractor shall remove all cartons, containers, crates, etc. under his control as soon as their contents have been removed. Waste shall be collected and placed in a location designated by the Construction Manager or General Contractor.

B. At the completion of work in any area, the Contractor shall clean all of his/her work, equipment, etc., making it free from dust, dirt and debris, etc.

C. At the completion of work, all equipment furnished under this Section shall be checked for paint damage, and any factory finished paint that has been damaged shall be repaired to match the adjacent areas. Any metal cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

2.14 PROTECTION

A. The Contractor shall protect all work and material from damage by his/her work or workers, and shall be liable for all damage thus caused.

B. The Contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The Contractor shall protect his/her work against theft or damage, and shall carefully store material and equipment received on site that is not immediately installed.
The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

2.15 FIELD QUALITY CONTROL

A. All work, materials and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this Section.

B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship. All visible piping and or wiring runs shall be installed parallel to building lines and properly supported.

C. Contractor shall arrange for field inspections by local and/or state authorities having jurisdiction over the work.

2.16 ACCEPTANCE

A. The control systems will not be accepted as meeting the requirements of Completion until all tests described in this specification have been performed to the satisfaction of both the Engineer and Owner. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the Completion requirements if stated as such in writing by the Owner’s representative. Such tests shall then be performed as part of the warranty.

END OF SECTION 23 09 00
SECTION 23 11 23
FACILITY NATURAL-GAS PIPING

PART 1 GENERAL

1.01 DRAWINGS AND GENERAL PROVISIONS OF THE CONTRACT, INCLUDING GENERAL AND SUPPLEMENTARY CONDITIONS AND DIVISION 01 SPECIFICATION SECTIONS, APPLY TO THIS SECTION.

1.02 SUMMARY

A. Section Includes:
   1. Pipes, tubes, and fittings.
   2. Piping specialties.
   3. Piping and tubing joining materials.
   4. Valves.
   5. Pressure regulators.

1.03 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, 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.

1.04 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:
   1. Piping and Valves: 100 psig minimum unless otherwise indicated.
   2. Service Regulators: 65 psig minimum unless otherwise indicated.
   3. Minimum Operating Pressure of Service Meter: 2psig.

B. Natural-Gas System Pressure within Buildings: 0.5 psig or less.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pressure regulators to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. 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.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

D. Protect stored PE pipes and valves from direct sunlight.
1.08 PROJECT CONDITIONS
A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.
B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:
   1. Notify Architect no fewer than two days in advance of proposed interruption of natural-gas service.

1.09 COORDINATION
A. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Section 08 31 13 "Access Doors and Frames."

PART 2 PRODUCTS

2.01 PIPES, TUBES, AND FITTINGS
A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
   4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
      b. End Connections: Threaded or butt welding to match pipe.
      c. Lapped Face: Not permitted underground.
      e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
   5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
      a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

2.02 PIPING SPECIALTIES
A. Appliance Flexible Connectors:
   2. Operating-Pressure Rating: 0.5 psig.
   5. Maximum Length: 72 inches
B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
   1. Copper-alloy convenience outlet and matching plug connector.
   2. Nitrile seals.
   3. Hand operated with automatic shutoff when disconnected.
   4. For indoor or outdoor applications.
   5. Adjustable, retractable restraining cable.
C. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.03 JOINING MATERIALS
A. Joint Compound and Tape: Suitable for natural gas.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.04 MANUAL GAS SHUTOFF VALVES

A. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
   1. CWP Rating: 125 psig.
   3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
   5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
   6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

B. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
   1. CWP Rating: 125 psig.
   2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
   4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

C. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. BrassCraft Manufacturing Company; a Masco company.
      c. Lyall, R. W. & Company, Inc.
      e. Perfection Corporation; a subsidiary of American Meter Company.
   3. Ball: Chrome-plated brass.
   4. Stem: Bronze; blowout proof.
   5. Seats: Reinforced TFE; blowout proof.
   6. Packing: Separate packnut with adjustable-stem packing threaded ends.
   8. CWP Rating: 600 psig.
   9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
   10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. BrassCraft Manufacturing Company; a Masco company.
      c. Lyall, R. W. & Company, Inc.
      e. Perfection Corporation; a subsidiary of American Meter Company.
   3. Ball: Chrome-plated bronze.
   4. Stem: Bronze; blowout proof.
   5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Two-Piece, Regular-Port Bronze Ball Valves with Bronze Trim: MSS SP-110.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. BrassCraft Manufacturing Company; a Masco company.
      c. Lyall, R. W. & Company, Inc.
      e. Perfection Corporation; a subsidiary of American Meter Company.
   2. Ball: Chrome-plated bronze.
   3. Stem: Bronze; blowout proof.
   4. Seats: Reinforced TFE.
   5. Packing: Threaded-body packnut design with adjustable-stem packing.
   7. CWP Rating: 600 psig.
   8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.

F. Bronze Plug Valves: MSS SP-78.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Lee Brass Company.
   5. Operator: Square head or lug type with tamperproof feature where indicated.
   6. Pressure Class: 125 psig.
   7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
   8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.05 PRESSURE REGULATORS

A. General Requirements:
   1. Single stage and suitable for natural gas.
   2. Steel jacket and corrosion-resistant components.
   3. Elevation compensator.
   4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Service Pressure Regulators: Comply with ANSI Z21.80.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 100 psig.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
   5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
   6. Orifice: Aluminum; interchangeable.
   8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
   9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
   11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   5. Seat Disc: Nitrile rubber.
   8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
   9. Maximum Inlet Pressure: .5psig.

2.06 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Central Plastics Company.
      d. Jomar International Ltd.
      e. Matco-Norca, Inc.
2. Description:
   b. Pressure Rating: 125 psig minimum at 180 deg F.
   c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Central Plastics Company.
      c. Matco-Norca, Inc.
      d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
      e. Wilkins; a Zurn company.
   2. Description:
      b. Factory-fabricated, bolted, companion-flange assembly.
      c. Pressure Rating: 125 psig minimum at 180 deg F.
      d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Central Plastics Company.
      d. Pipeline Seal and Insulator, Inc.
   2. Description:
      a. Nonconducting materials for field assembly of companion flanges.
      b. Pressure Rating: 150 psig.
      c. Gasket: Neoprene or phenolic.
      d. Bolt Sleeves: Phenolic or polyethylene.
      e. Washers: Phenolic with steel backing washers.

2.07 LABELING AND IDENTIFYING
   A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 EXECUTION
3.01 EXAMINATION
   A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
   B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION
   A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
   B. Inspect natural-gas piping according to NFPA 54 the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
   C. Comply with NFPA 54 the International Fuel Gas Code requirements for prevention of accidental ignition.
3.03 OUTDOOR PIPING INSTALLATION
   A. Comply with NFPA 54 the International Fuel Gas Code for installation and purging of natural-gas piping.
   B. Steel Piping with Protective Coating:
      1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
      2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
      3. Replace pipe having damaged PE coating with new pipe.
   C. Install fittings for changes in direction and branch connections.

3.04 INDOOR PIPING INSTALLATION
   A. Comply with NFPA 54 the International Fuel Gas Code for installation and purging of natural-gas piping.
   B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
   C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
   D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
   E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
   F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
   G. Locate valves for easy access.
   H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
   I. Install piping free of sags and bends.
   J. Install fittings for changes in direction and branch connections.
   K. Verify final equipment locations for roughing-in.
   L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
   M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
      1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
   N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
   O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
   P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
      1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.

3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.

4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
   a. Exception: Tubing passing through partitions or walls does not require striker barriers.

5. Prohibited Locations:
   a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
   b. Do not install natural-gas piping in solid walls or partitions.

Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

R. Connect branch piping from top or side of horizontal piping.

S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

T. Do not use natural-gas piping as grounding electrode.

U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

V. Install pressure gage downstream from each line regulator. Pressure gages are specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."

W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

3.05 VALVE INSTALLATION

A. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.06 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:
   1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
   2. Cut threads full and clean using sharp dies.
   3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
   4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
   5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

F. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

3.07 HANGER AND SUPPORT INSTALLATION
A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."

B. Comply with requirements for pipe hangers and supports specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
   1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
   2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
   3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
   4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
   5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

D. Install hangers for horizontal drawn-temper copper tubing with the following maximum spacing and minimum rod sizes:
   1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
   2. NPS 1/2 and NPS 5/8: Maximum span, 72 inches; minimum rod size, 3/8 inch.
   3. NPS 3/4 and NPS 7/8: Maximum span, 84 inches; minimum rod size, 3/8 inch.
   4. NPS 1: Maximum span, 96 inches; minimum rod size, 3/8 inch.

E. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
   1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
   2. NPS 1/2: Maximum span, 72 inches; minimum rod size, 3/8 inch.
   3. NPS 3/4 and Larger: Maximum span, 96 inches; minimum rod size, 3/8 inch.

3.08 CONNECTIONS
A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.09 LABELING AND IDENTIFYING
A. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.10 PAINTING
A. Comply with requirements in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting" for painting interior and exterior natural-gas piping.
B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
   1. Alkyd System: MPI EXT 5.1D.
      c. Topcoat: Exterior alkyd enamel (semigloss).
      d. Color: Gray.

C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
   1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
      c. Topcoat: Interior latex (semigloss).
      d. Color: yellow.
   2. Alkyd System: MPI INT 5.1E.
      c. Topcoat: Interior alkyd (semigloss).
      d. Color: yellow.

D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.11 FIELD QUALITY CONTROL
   A. Perform tests and inspections.
   B. Tests and Inspections:
      1. Test, inspect, and purge natural gas according to NFPA 54 the International Fuel Gas Code and authorities having jurisdiction.
   C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
   D. Prepare test and inspection reports.

3.12 DEMONSTRATION
   A. Engage a factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain earthquake valves.

3.13 OUTDOOR PIPING SCHEDULE
   A. Aboveground natural-gas piping shall be one of the following:
      1. Steel pipe with malleable-iron fittings and threaded joints.
      2. Steel pipe with wrought-steel fittings and welded joints.

3.14 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG
   A. Aboveground, branch piping 2 ½” and smaller shall be one of the following:
      1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
      2. Annealed-temper, tin-lined copper tube with flared joints and fittings.
      3. Annealed-temper, copper tube with wrought-copper fittings and brazed joints.
      4. Aluminum tube with flared fittings and joints.
      5. Steel pipe with malleable-iron fittings and threaded joints.
   B. Aboveground, distribution piping shall be one of the following:
      1. Steel pipe with malleable-iron fittings and threaded joints.
      2. Steel pipe with wrought-steel fittings and welded joints.
      3. Drawn-temper copper tube with wrought-copper fittings and brazed joints.
C. Underground, below building, piping shall be one of the following:
   1. Steel pipe with malleable-iron fittings and threaded joints.
   2. Steel pipe with wrought-steel fittings and welded joints.

D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.15 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:
   1. One-piece, bronze ball valve with bronze trim.
   2. Two-piece, full-port, bronze ball valves with bronze trim.

B. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be one of the following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.
   2. Bronze plug valve.
   3. Cast-iron, nonlubricated plug valve.

C. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:
   1. One-piece, bronze ball valve with bronze trim.
   2. Two-piece, full-port, bronze ball valves with bronze trim.

D. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be one of the following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.
   2. Bronze plug valve.
   3. Cast-iron, lubricated plug valve.

E. Valves in branch piping for single appliance shall be one of the following:
   1. One-piece, bronze ball valve with bronze trim.
   2. Two-piece, full-port, bronze ball valves with bronze trim.

END OF SECTION 23 11 23
SECTION 23 21 13
HYDRONIC PIPING

PART 1 GENERAL

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

1.02 SUMMARY
   A. Section includes pipe and fitting materials and joining methods for the following:
      1. Loop water piping, chilled, and heating hot water piping.
      2. Condensate-drain piping.
      3. Air-vent piping.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS
   A. Hydronic piping components and installation shall be capable of withstanding the following
      minimum working pressure and temperature unless otherwise indicated:
      1. Loop Water Piping, chilled water, and heating hot water piping: at 200 deg F.
      2. Condensate-Drain Piping: 150 deg F.
      3. Air-Vent Piping: 200 deg F.
      4. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which
         it is attached.

2.02 COPPER TUBE AND FITTINGS
   A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
   B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
   C. DWV Copper Tubing: ASTM B 306, Type DWV.
   D. Wrought-Copper Unions: ASME B16.22.

2.03 STEEL PIPE AND FITTINGS
   A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and
      wall thickness as indicated in "Piping Applications" Article.
   B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping
      Applications" Article.
   C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping
      Applications" Article.
   D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping
      Applications" Article.
   E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised
      ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.
   F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
   G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts,
      nuts, and gaskets of the following material group, end connections, and facings:
      2. End Connections: Butt welding.
      3. Facings: Raised face.
   H. Grooved Mechanical-Joint Fittings and Couplings:
      1. Manufacturers: Subject to compliance with requirements, provide products by one of the
         following:
         a. Anvil International, Inc.
b. Central Sprinkler Company.
c. Star Pipe Products.
d. Victaulic Company.

2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106/A 106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

3. Couplings: Ductile- or malleable-iron housing and EPDM or nitrile gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

I. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.04 JOINING MATERIALS
A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
E. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
F. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.05 TRANSITION FITTINGS
A. Plastic-to-Metal Transition Fittings:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      b. IPEX Inc.
      c. KBI (King Bros. Industries).
   2. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.
B. Plastic-to-Metal Transition Unions:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      b. IPEX Inc.
      c. KBI (King Bros. Industries).
      d. NIBCO INC; Model #T/S-1710.
   2. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.
2.06 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. A.Y. McDonald Mfg. Co.
      b. Capitol Manufacturing Company.
      c. Central Plastics Company.
      d. Hart Industries International, Inc.
      e. Jomar International, Ltd.
      f. Matco-Norca.
      g. Watts Regulator Co.
      h. Zurn Industries, LLC; AquaSpec Commercial Faucet Products.
   2. Description:
      b. Pressure Rating: 150 psig.
      c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      b. Central Plastics Company.
      c. Matco-Norca.
      d. Watts Regulator Co.
      e. Zurn Industries, LLC; AquaSpec Commercial Faucet Products.
   2. Description:
      b. Factory-fabricated, bolted, companion-flange assembly.
      c. Pressure Rating: 150 psig.
      d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Central Plastics Company.
      d. Pipeline Seal and Insulator, Inc.
   2. Description:
      a. Nonconducting materials for field assembly of companion flanges.
      b. Pressure Rating: 150 psig.
      c. Gasket: Neoprene or phenolic.
      d. Bolt Sleeves: Phenolic or polyethylene.
      e. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Elster Perfection.
b. Grinnell Mechanical Products.
c. Matco-Norca.
d. Precision Plumbing Products, Inc.
e. Victaulic Company.

2. Description:
   b. Electroplated steel nipple, complying with ASTM F 1545.
   c. Pressure Rating: 300 psig at 225 deg F.
   d. End Connections: Male threaded or grooved.
   e. Lining: Inert and noncorrosive, propylene.

PART 3 EXECUTION

3.01 PIPING APPLICATIONS

A. Loop water, chilled water, and heating hot water piping, aboveground, NPS 2 and smaller, shall be the following:
   1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.

B. Loop water, chilled water, and heating hot water piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
   1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
   2. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

C. Condensate-Drain Piping: Type M, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

D. Air-Vent Piping:
   1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
   2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

E. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

3.02 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Section 23 05 23 "General-Duty Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install shutoff valve immediately upstream of each dielectric fitting.

T. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for identifying piping.

U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 23 05 17 "Sleeves and Sleeve Seals for HVAC Piping."

V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 23 05 18 "Escutcheons for HVAC Piping."

3.03 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.04 HANGERS AND SUPPORTS

A. Comply with requirements in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 7 feet.
2. NPS 1: Maximum span, 7 feet.
3. NPS 1-1/2: Maximum span, 9 feet.
4. NPS 2: Maximum span, 10 feet.
5. NPS 2-1/2: Maximum span, 11 feet.
6. NPS 3 and Larger: Maximum span, 12 feet.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.
E. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

3.05 PIPE JOINT CONSTRUCTION
A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
D. 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/A5.8M.
E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
H. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.
I. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

3.06 TERMINAL EQUIPMENT CONNECTIONS
A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
B. Install control valves in accessible locations close to connected equipment.
C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 23 05 19 "Meters and Gages for HVAC Piping."

3.07 FIELD QUALITY CONTROL
A. Prepare hydronic piping according to ASME B31.9 and as follows:
   1. Leave joints, including welds, uninsulated and exposed for examination during test.
   2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
   3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
   4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
   5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
B. Perform the following tests on hydronic piping:
   1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
   2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
   3. Isolate expansion tanks and determine that hydronic system is full of water.
   4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
   5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
   6. Prepare written report of testing.

C. Perform the following before operating the system:
   1. Open manual valves fully.
   2. Inspect pumps for proper rotation.
   3. Set makeup pressure-reducing valves for required system pressure.
   4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
   5. Set temperature controls so all coils are calling for full flow.
   6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
   7. Verify lubrication of motors and bearings.

END OF SECTION 23 21 13
PART 2 PRODUCTS

HYDRONIC SPECIALTIES

1.01 COMPRESSION TANKS

A. Construction: Closed, welded steel, tested, and stamped in accordance with ASME BPVC-VIII-1; cleaned, prime coated, and supplied with steel support saddles; with tappings for installation of accessories.
   1. Pressure rating: 100 psi.

B. Gauge Glass Set: Brass compression stops, guard, and 3/4 inch red line glass, maximum 24 inches length, long enough to cover tank for 2 inches above bottom to 2 inches below top.

C. Quick Connect Air Inlet:
   1. Compressed Air: 75 inches of 1/4 inch diameter braided reinforced air hose, air chuck, check valve, and shut-off valve on supply from control air compressor.
   2. Expansion Tank: Inlet tire check valve, manual air vent, tank drain, and pressure relief valve.

1.02 AIR VENTS

A. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.

B. Float Type:
   1. Cast iron body and cover, float, bronze pilot valve mechanism suitable for system operating temperature and pressure; with isolating valve.

C. Washer Type:
   1. Brass with hygroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring loaded ball check valve.

1.03 AIR SEPARATORS

A. Coalescing Air/Dirt Separators:
   1. Manufacturers:
      b. __________.
   2. Tank: Fabricated steel tank; tested and stamped in accordance with ASME BPVC-VIII-1; for 150 psi operating pressure and 270 degrees F maximum operating temperature; subject to the requirements of the application and the manufacturer's standard maximum operating conditions.
   3. Coalescing Medium: Provide stainless steel medium filling the entire vessel to suppress turbulence and provide air elimination efficiency of 100 percent free air, 100 percent entrained air, and 99.6 percent dissolved air at the installed location.
   4. Air Vent: Integral float actuated air vent at top fitting of tank rated at 150 psi, threaded to the top of the separator.
   5. Inlet and Outlet Connections: Threaded for 2 NPS and smaller; Class 150 flanged connections for 2-1/2 NPS and larger.
   7. Size: Match system flow capacity.

1.04 STRainers

A. Manufacturers:

B. Size 2 inch and Under:
   1. Screwed brass or iron body for 175 psi working pressure, Y pattern with 1/32 inch stainless steel perforated screen.
C. Size 2-1/2 inch to 4 inch:
   1. Provide flanged or grooved iron body for 175 psi working pressure, Y pattern with 1/16 inch, or 3/64 inch stainless steel perforated screen.

D. Size 5 inch and Larger:

1.05 SUCTION DIFFUSERS
A. Fitting: Angle pattern, cast-iron body, threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger, rated for 175 psi working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable 5/32 inch mesh strainer to fit over cylinder strainer, 20 mesh start up screen, and permanent magnet located in flow stream and removable for cleaning.

1.06 PUMP CONNECTORS
A. Flexible Connectors: Flanged, braided type with wetted components of stainless steel, sized to match piping.
   1. Maximum Allowable Working Pressure: 150 psig at 120 degrees F.
   2. Accommodate the Following:
      b. Lateral Movement: _____ inch.
      c. Angular Rotation: 15 degrees.
      d. Force developed by 1.5 times specified maximum allowable operating pressure.
   3. End Connections: Same as specified for pipe jointing.
   4. Provide pump connector with integral vanes to reduce turbulent flow.
   5. Provide necessary accessories including, but not limited to, swivel joints.

1.07 COMBINATION PUMP DISCHARGE VALVES
A. Manufacturers:
B. Valves: Straight or angle pattern, flanged cast-iron valve body with bolt-on bonnet for 175 psi operating pressure, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation.

1.08 PRESSURE-TEMPERATURE TEST PLUGS
A. Manufacturers:
B. Construction: Brass body designed to receive temperature or pressure probe with removable protective cap, and Neoprene rated for minimum 200 degrees F.
C. Application: Use extended length plugs to clear insulated piping.

1.09 BALANCING VALVES
A. Manufacturers:
   4. ITT Bell & Gossett: www.bellgossett.com/#sle.
   5. Taco, Inc; ______: www.taco-hvac.com/#sle.
B. Size 2.5 inch and Larger:
   1. Provide ball, globe, or butterfly style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and flanged, grooved, or weld end connections.
   2. Valve body construction materials consist of cast iron, carbon steel, or ductile iron.
   3. Internal components construction materials consist of brass, aluminum bronze, bronze, Teflon, EPDM, NORYL, or engineered resin.
1.10 COMBINATION FLOW CONTROLS

A. Manufacturers:
   3. ITT Bell & Gossett: www.bellgossett.com/#sle.

B. Construction: Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet with blowdown/backflush drain.

C. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.

D. Provide with inlet and outlet unions as required.

E. Control Mechanism: Stainless steel or nickel plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring.

1.11 RELIEF VALVES

A. Manufacturers:
   3. ITT Bell & Gossett: www.bellgossett.com/#sle.

B. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

1.12 PRESSURE REDUCING VALVES

A. Manufacturers:
   3. ITT Bell & Gossett: www.bellgossett.com/#sle.

B. Operation: Automatically feeds make-up water to the hydronic system whenever pressure in the system drops below the pressure setting of the valve. Refer to Section 23 21 13.

C. Materials of Construction:
   1. Valve Body: Constructed of bronze, cast iron, brass, or iron.
   2. Internal Components: Construct of stainless steel or brass and engineered plastics or composition material.

D. Connections:
   1. NPT threaded: 0.50 inch, or 0.75 inch.
   2. Soldered: 0.50 inch.

E. Provide integral check valve and strainer.

F. Maximum Inlet Pressure: 100 psi.

G. Maximum Fluid Temperature: 180 degrees F.

H. Operating Pressure Range: Between 10 psi and 25 psi.

1.13 AUTOMATIC FLOW LIMITING VALVES

A. Manufacturers:

B. Size 0.50 inch to 14 inch:
   1. Provide ball or globe style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and NPT threaded or soldered connections.
   2. Metal construction materials consist of bronze or brass.
3. Non-metal construction materials consist of Teflon, EPDM, or engineered resin.

1.14 GLYCOL SYSTEM

PART 3 EXECUTION

2.01 INSTALLATION

A. Install specialties in accordance with manufacturer's instructions.

B. Where large air quantities can accumulate, provide enlarged air collection standpipes.

C. Provide manual air vents at system high points and as indicated.

D. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.

E. Provide air separator on suction side of system circulation pump and connect to expansion tank.

F. Provide valved drain and hose connection on strainer blow down connection.

G. Provide pump suction fitting on suction side of base mounted centrifugal pumps where indicated. Remove temporary strainers after cleaning systems.

H. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps where indicated.

I. Support pump fittings with floor mounted pipe and flange supports.

J. Provide radiator valves on water inlet to terminal heating units such as radiation, unit heaters, and fan coil units.

K. Provide radiator balancing valves on water outlet from terminal heating units such as radiation, unit heaters, and fan coil units.

L. Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.

M. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

N. Pipe relief valve outlet to nearest floor drain.

O. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

P. Clean and flush glycol system before adding glycol solution. Refer to Section 23 25 00.

Q. Feed glycol solution to system through make-up line with pressure regulator, venting system high points.

END OF SECTION 23 21 14
SECTION 23 25 13
WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS

PART 1 GENERAL
1.01 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
   A. Section includes the following water treatment for closed-loop hydronic systems:
      1. Filter Housing Equipment
      2. Chemicals.

1.03 ACTION SUBMITTALS
   A. Product Data: Include rated capacities, operating characteristics, and furnished specialties and accessories for the following products:
      1. Bypass feeders.
      2. Chemical material safety data sheets.
      3. Contractor shall be responsible to submit 3 water/glycol samples taken directly from the system the first sample will be taken after the geothermal field has been filled by the geothermal contractor, the second sample will be taken after the fill of the interior building loop (prior to opening the system to the ground loop) The third sample will be taken after the ground loop is combined and circulated with the building loop for 1 week ) The testing will by an independent testing agency that will draw the samples and submit a report indicating the chemical concentrations at the completion of the system combination of the interior and exterior piping systems. Coordinate this with the well field contractor. The wellfield contractor will have the first test sample taken at the completion of their work. Utilize the same testing agency to submit a final completed report indicating all 3 test samples.

1.04 INFORMATIONAL SUBMITTALS
   A. Water Analysis Provider Qualifications: Verification of experience and capability of HVAC water-treatment service provider.

1.05 QUALITY ASSURANCE
   A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

PART 2 PRODUCTS
2.01 PERFORMANCE REQUIREMENTS
   A. Water quality for hydronic systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of hydronic equipment without creating a hazard to operating personnel or the environment.
   B. Base HVAC water treatment on quality of water available at Project site, hydronic system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.
   C. Closed hydronic systems, including glycol loop, shall have the following water qualities:
      1. pH: Maintain a value within 9.0 to 10.5.
      2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
      3. Boron: Maintain a value within 100 to 200 ppm.
      5. Soluble Copper: Maintain a maximum value of 0.20 ppm.
      6. TSS: Maintain a maximum value of 10 ppm.
9. Microbiological Limits:
   a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/mL.
   b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/mL.
   c. Nitrate Reducers: Maintain a maximum value of 100 organisms/mL.
   d. Sulfate Reducers: Maintain a maximum value of zero organisms/mL.
   e. Iron Bacteria: Maintain a maximum value of zero organisms/mL.

2.02 FILTRATION EQUIPMENT
   A. Filter Housing:
      1. Flow Max 5x1, 316 SS
      2. Minimum Working Pressure: 175 psig
      3. Pipe Connections NPS 2 and Smaller: Threaded according to ASME B1.20.1.
      4. Steel Housing Pipe Connections NPS 2-1/2 and Larger: Steel, Class 150 flanges
         according to ASME B16.5 or grooved according to AWWA C606.

2.03 CHEMICALS
   A. Chemicals shall be as recommended by water-treatment system manufacturer that are
      compatible with piping system components and connected equipment and that can attain water
      quality specified in "Performance Requirements" Article.

PART 3 EXECUTION
3.01 WATER ANALYSIS
   A. Perform an analysis of supply water to determine quality of water available at Project site.
   B. Contractor shall utilize Chemsearch Solutions Water Treatment Specialists for water treatment
      of the building hydronic systems. Contact Kurt Peterson at 800-527-9921 or mobile:
      515-491-5534. kurt.peterson@chemsearch.com

END OF SECTION 23 25 13
SECTION 23 31 13
METAL DUCTS

PART 1 GENERAL

1.01 DRAWINGS AND GENERAL PROVISIONS OF THE CONTRACT, INCLUDING GENERAL AND SUPPLEMENTARY CONDITIONS AND DIVISION 01 SPECIFICATION SECTIONS, APPLY TO THIS SECTION.

1.02 SUMMARY

A. Section Includes:
1. Single-wall rectangular ducts and fittings.
2. Single-wall round and flat-oval ducts and fittings.
3. Double-wall round and flat-oval ducts and fittings.
4. Sheet metal materials.
5. Duct liner.
7. Hangers and supports.

B. Related Sections:
1. Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 23 33 00 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of the following products:
1. Liners and adhesives.
2. Sealants and gaskets.

B. Shop Drawings:
1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

1.04 QUALITY ASSURANCE


B. Welding Qualifications: Qualify procedures and personnel according to the following:
C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 PRODUCTS

2.01 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.02 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Lindab Inc.
   b. McGill AirFlow LLC.
   c. SEMCO Incorporated.
   d. Sheet Metal Connectors, Inc.
   e. Spiral Manufacturing Co., Inc.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

   1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

   1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
   2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.03 DOUBLE-WALL ROUND DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Lindab Inc.
2. McGill AirFlow LLC.
3. SEMCO Incorporated.
4. Sheet Metal Connectors, Inc.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   a. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
   b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch-diameter perforations, with overall open area of 23 percent.

E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.
4. Cover insulation with polyester film complying with UL 181, Class 1.

2.04 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. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

D. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

E. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
   1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.05 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CertainTeed Corporation; Insulation Group.
      b. Johns Manville.
      c. Knauf Insulation.
      d. Owens Corning.
      e. Maximum Thermal Conductivity:
         1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
   2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
   3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

B. Insulation Pins and Washers:
   1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
   2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick stainless steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
   1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
   2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
   3. Butt transverse joints without gaps, and coat joint with adhesive.
   4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
   5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

7. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
   a. Fan discharges.
   b. Intervals of lined duct preceding unlined duct.
   c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

8. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.06 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:
   1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
   2. Tape Width: 4 inches.
   5. Mold and mildew resistant.
   6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
   7. Service: Indoor and outdoor.
   8. Service Temperature: Minus 40 to plus 200 deg F.
   9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

C. Water-Based Joint and Seam Sealant:
   1. Application Method: Brush on.
   2. Solids Content: Minimum 65 percent.
   5. Mold and mildew resistant.
   6. VOC: Maximum 75 g/L (less water).
   7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
   8. Service: Indoor or outdoor.
   9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.
   2. Type: S.
   3. Grade: NS.
   5. Use: O.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:
   1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
   2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.07 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. 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.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:
   3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 EXECUTION

3.01 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 and flat-oval ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.
3.02 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.03 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.
B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings.
C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.
D. Kitchen and Grill Hood (Ventilator) Exhaust Ducts: Comply with NFPA 96. 1. Material: 1.6 mm (16 gage) steel sheet (black iron), ASTM A1011, or 1.3 mm (18 gage) stainless steel. Use stainless steel for exposed duct in occupied areas. See Optional Duct Materials.
E. Construction: Liquid tight with continuous external weld for all seams and joints. Where ducts are not self draining back to the equipment, provide low point drain pocket with copper drain pipe to sanitary sewer. Provide access doors or panels for duct cleaning inside of horizontal duct at drain pockets, at 6 m (20 feet) intervals, and at each change of direction.
F. Access doors or panels shall be of the same material and thickness of the duct with gaskets and sealants that are rated 815 degrees C (1500 degrees F) and shall be grease-tight.
G. Grease Duct: Double-wall factory-built grease duct, UL labeled and complying with NFPA 96 may be furnished in lieu of specified materials for kitchen and grill hood exhaust.

3.04 SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.05 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.
   2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
   4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
D. Hangers Exposed to View: Threaded rod and angle or channel supports.
E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.06 CONNECTIONS
A. Make connections to equipment with flexible connectors complying with Section 23 33 00 "Air Duct Accessories."
B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.07 PAINTING
A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
B. Exposed spiral ducts in the Gymnasium, Locker rooms, Media Center, Commons, Student Lockers, and Collaboration areas. shall be consist of exterior paint grip surface suitable for field painting. The contractor is responsible to clean all surfaces free of dust, and oils after installation for painting preparation.

3.08 FIELD QUALITY CONTROL
A. Perform tests and inspections.
B. Duct system will be considered defective if it does not pass tests and inspections.

3.09 START UP
A. Air Balance: Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC."

3.10 DUCT SCHEDULE
A. Fabricate ducts with galvanized sheet steel except as indicated on the drawings:
B. Supply Ducts:
   1. Ducts Connected to Fan Coil Units, Heat Pumps, and Terminal Units:
      a. Pressure Class: Positive 2-inch wg.
      b. Minimum SMACNA Seal Class: A.
      c. SMACNA Leakage Class for Rectangular: 12.
      d. SMACNA Leakage Class for Round and Flat Oval: 12.
   2. Ducts Connected to Energy Recovery Units:
      a. Pressure Class: Positive 2-inch wg.
      b. Minimum SMACNA Seal Class: A.
      c. SMACNA Leakage Class for Rectangular: 12.
      d. SMACNA Leakage Class for Round and Flat Oval: 12.
C. Return Ducts:
   1. Ducts Connected to Fan Coil Units, Heat Pumps, and Terminal Units:
      a. Pressure Class: Positive or negative 1-inch wg.
      b. Minimum SMACNA Seal Class: A.
      c. SMACNA Leakage Class for Rectangular: 12.
      d. SMACNA Leakage Class for Round and Flat Oval: 12.
   2. Ducts Connected to Energy Recovery Units:
      a. Pressure Class: Positive or negative 2-inch wg.
      b. Minimum SMACNA Seal Class: B.
SMACNA Leakage Class for Rectangular: 12.
SMACNA Leakage Class for Round and Flat Oval: 12.

D. Exhaust Ducts:
1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
   a. Pressure Class: Negative 2-inch wg.
   b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 12.
2. Ducts Connected to Make Up air Units:
   a. Pressure Class: Positive or negative 2-inch wg.
   b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 12.
3. Ducts Connected to Dishwasher Hoods:
   a. Type 304, stainless-steel sheet.
   b. Exposed to View: No. 4 finish.
   c. Concealed: No. 2D finish.
   d. Welded seams and flanged joints with watertight EPDM gaskets.
   e. Pressure Class: Positive or negative 2-inch wg.
   f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
   g. SMACNA Leakage Class: 3.
   a. Exposed to View: Type 304, stainless-steel sheet.
   b. Concealed: Type 304, stainless-steel sheet, No. 2D finish or Carbon-steel sheet.
   c. Welded seams and joints.
   d. Pressure Class: Positive or negative 2-inch wg.
   e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
   f. SMACNA Leakage Class: 3

E. Intermediate Reinforcement:

F. Liner:
1. Metal ducts with duct liner are to be of sufficient thickness and density to comply with energy code and ASHRAE/IESNA 90.1.
2. All exposed and concealed Supply and Return ducts and plenums are to be lined, except where indicated other on the drawings.
3. Supply Air Ducts: Fibrous glass, Type I, 1 inch thick.
4. Return Air Ducts: Fibrous glass, Type I, 1 inch thick.
5. Refer to drawings for duct insulation schedule.

G. Double-Wall Duct Interstitial Insulation (Exposed Gymnasium ducts and Library exposed spiral):
1. Supply Air Ducts: 1 inch thick. (double wall spiral duct)
2. Return Air Ducts: 1 inch thick. (double wall spiral)

H. Elbow Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
   a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
   b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
   c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
   a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered
Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Radius-to Diameter Ratio: 1.5.
   a. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
   b. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

I. Branch Configuration:
   1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
      a. Rectangular Main to Rectangular Branch: 45-degree entry.
      b. Rectangular Main to Round Branch: Spin in.
   2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
      a. Velocity 1000 fpm or Lower: 90-degree tap.
      b. Velocity 1000 to 1500 fpm: Conical tap.
      c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 23 31 13
SECTION 23 33 00
AIR DUCT ACCESSORIES

PART 1 GENERAL

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

1.02 SUMMARY
   A. Section Includes:
      2. Flange connectors.
      3. Turning vanes.
      4. Duct-mounted access doors.
      5. Flexible connectors.
      6. Flexible ducts.
      7. Duct accessory hardware.
   B. Related Requirements:
      1. Section 23 37 23 "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
      2. Section 28 31 11 "Digital, Addressable Fire-Alarm System" for duct-mounted fire and
         smoke detectors.

1.03 ACTION SUBMITTALS
   A. 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.
            c. Control-damper installations.
            d. Duct security bars.
            e. Wiring Diagrams: For power, signal, and control wiring.

1.04 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For air duct accessories to include in operation and
      maintenance manuals.

PART 2 PRODUCTS

2.01 ASSEMBLY DESCRIPTION
   A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with
      NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
   B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for
      acceptable materials, material thicknesses, and duct construction methods unless otherwise
      indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains,
      discolorations, and other imperfections.

2.02 MATERIALS
   A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
      1. Galvanized Coating Designation: G60.
      2. Exposed-Surface Finish: Mill phosphatized.
   B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish
      for concealed ducts.
   C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for
      concealed ducts and standard, 1-side bright finish for exposed ducts.
D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.03 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Air Balance Inc.; a division of Mestek, Inc.
      b. American Warming and Ventilating; a division of Mestek, Inc.
      c. Flexmaster U.S.A., Inc.
      d. McGill AirFlow LLC.
      e. Nailor Industries Inc.
      f. Pottorff.
      g. Ruskin Company.
   2. Standard leakage rating.
   3. Suitable for horizontal or vertical applications.
   4. Frames:
      a. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel.
      b. Mitered and welded corners.
      c. Flanges for attaching to walls and flangeless frames for installing in ducts.
   5. Blades:
      a. Multiple or single blade.
      b. Parallel- or opposed-blade design.
      c. Stiffen damper blades for stability.
      d. Galvanized-steel, 0.064 inch thick.
   7. Bearings:
      a. Oil-impregnated bronze.
      b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
   8. Tie Bars and Brackets: Galvanized steel.

B. Damper Hardware:
   2. Include center hole to suit damper operating-rod size.
   3. Include elevated platform for insulated duct mounting.

2.04 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.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.
2.05 TURNING VANES

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. Duro Dyne Inc.
   3. Eigen Manufacturing.
   4. METALAIRE, Inc.
   5. SEMCO Incorporated.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

E. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.06 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. American Warming and Ventilating; a division of Mestek, Inc.
   2. Cesco Products; a division of Mestek, Inc.
   3. Ductmate Industries, Inc.
   4. Eigen Manufacturing.
   5. Flexmaster U.S.A., Inc.
   7. McGill AirFlow LLC.
   8. Nailor Industries Inc.
   10. Ventfabrics, Inc.

   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: and two sash locks.
      c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches.
      d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.
2.07 FLEXIBLE 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. Duro Dyne Inc.
   3. Elgen Manufacturing.
   4. Ventfabrics, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.

   1. Minimum Weight: 26 oz./sq. yd.
   2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
   3. Service Temperature: Minus 40 to plus 200 deg F.

   1. Minimum Weight: 16 oz./sq. yd.
   2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
   3. Service Temperature: Minus 67 to plus 500 deg F.

2.08 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Flexmaster U.S.A., Inc.
   2. McGill AirFlow LLC.

B. Noninsulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire.
   1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
   3. Temperature Range: Minus 10 to plus 160 deg F.

C. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
   1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
   3. Temperature Range: Minus 10 to plus 160 deg F.
   4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

D. Flexible Duct Connectors:
   1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

2.09 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

3.01 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

D. Set dampers to fully open position before testing, adjusting, and balancing.

E. Install test holes at fan inlets and outlets and elsewhere as indicated.

F. Install fire and smoke dampers according to UL listing.

G. Connect ducts to duct silencers rigidly.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
   1. On both sides of duct coils.
   2. At outdoor-air intakes and mixed-air plenums.
   3. At drain pans and seals.
   4. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links.
      Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
   5. Control devices requiring inspection.
   6. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:
   1. One-Hand or Inspection Access: 8 by 5 inches.
   2. Two-Hand Access: 12 by 6 inches.

K. Label access doors according to Section 23 05 53 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. Connect diffusers or light troffer boots to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.

N. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.

O. Install duct test holes where required for testing and balancing purposes.

3.02 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Operate dampers to verify full range of movement.
   2. Inspect locations of access doors and verify that purpose of access door can be performed.
   3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

END OF SECTION 23 33 00
SECTION 23 34 23
HVAC POWER VENTILATORS

PART 1 GENERAL

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

1.02 SUMMARY
   A. Section Includes:
      1. Centrifugal roof ventilators.

1.03 PERFORMANCE REQUIREMENTS
   A. Project Altitude: Base fan-performance ratings on actual Project site elevations.
   B. Operating Limits: Classify according to AMCA 99.

1.04 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated. Include rated capacities, operating
      characteristics, and furnished specialties and accessories. Also include the following:
      1. Certified fan performance curves with system operating conditions indicated.
      2. Certified fan sound-power ratings.
      3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
      4. Material thickness and finishes, including color charts.
      5. Dampers, including housings, linkages, and operators.
      6. Roof curbs.
      7. Fan speed controllers.
   B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
      1. Detail equipment assemblies and indicate dimensions, weights, loads, required
         clearances, method of field assembly, components, and location and size of each field
         connection.
      2. Wiring Diagrams: For power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For power ventilators to include in emergency, operation,
      and maintenance manuals.

1.06 QUALITY ASSURANCE
   A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70,
      by a qualified testing agency, and marked for intended location and application.
   B. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for
      restaurant kitchen exhaust shall also comply with UL 762.

1.07 COORDINATION
   A. Coordinate size and location of structural-steel support members.
   B. Coordinate sizes and locations of concrete bases with actual equipment provided.
   C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with
      actual equipment provided.

PART 2 PRODUCTS

2.01 CENTRIFUGAL ROOF VENTILATORS
   A. Manufacturers: Subject to compliance with requirements, provide products by one of the
      following:
      1. Acme Engineering & Manufacturing Corporation.
      2. Aerovent; a division of Twin City Fan Companies, Ltd.
      3. Carnes Company.
5. Greenheck Fan Corporation.
7. Loren Cook Company.
8. PennBarry.
9. Quietaire Inc.

B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.

C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

D. Belt Drives: (Refer to schedule on drawing for locations)
1. Resiliently mounted to housing.
2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
5. Fan and motor isolated from exhaust airstream.

E. Accessories:
1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent. (Refer to schedule on drawing for locations)
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
4. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops. Refer to drawings for locations.

F. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch-thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
1. Configuration: Self-flashing without a cant strip, with mounting flange.
2. Overall Height: (refer to drawings for curb heights).

G. Capacities and Characteristics: As scheduled on the drawings.
1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent. Refer to drawings for details. (to schedule on drawing for locations).
2. Companion Flanges: For inlet and outlet duct connections.
3. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
4. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

H. Capacities and Characteristics: As scheduled on the drawings

2.02 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Enclosure Type: Totally enclosed, fan cooled. Refer to drawing schedule for additional details.
2.03 SOURCE QUALITY CONTROL
   A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
   B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 EXECUTION

3.01 INSTALLATION
   A. Install power ventilators level and plumb.
   B. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. See Section 07 72 00 "Roof Accessories" for installation of roof curbs.
   C. Support suspended units from structure using threaded steel rods and elastomeric hangers having a static deflection of 1 inch.
   D. Install units with clearances for service and maintenance.
   E. Label units according to requirements specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."

3.02 CONNECTIONS
   A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 23 33 00 "Air Duct Accessories."
   B. Install ducts adjacent to power ventilators to allow service and maintenance.
   C. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
   D. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.03 FIELD QUALITY CONTROL
   A. Perform tests and inspections.
   B. Tests and Inspections:
      1. Verify that shipping, blocking, and bracing are removed.
      2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
      3. Verify that cleaning and adjusting are complete.
      4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
      5. Adjust belt tension.
      6. Adjust damper linkages for proper damper operation.
      7. Verify lubrication for bearings and other moving parts.
      8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
      9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
     10. Shut unit down and reconnect automatic temperature-control operators.
     11. Remove and replace malfunctioning units and retest as specified above.
   C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3.04 ADJUSTING

A. Adjust damper linkages for proper damper operation.
B. Adjust belt tension if applicable.
C. Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
D. Replace fan and motor pulleys as required to achieve design airflow.
E. Lubricate bearings.

END OF SECTION 23 34 23
SECTION 23 36 00
AIR TERMINAL UNITS

PART 1 GENERAL

1.01 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
   A. Section Includes:
      1. Shutoff, single-duct air terminal units.
      2. Casing liner.

1.03 ACTION SUBMITTALS
   A. Product Data: For each type of air terminal unit.
      1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for air terminal units.
      2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
   B. Shop Drawings: For air terminal units.
      1. Include plans, elevations, sections, and mounting details.
      2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
      3. Include diagrams for power, signal, and control wiring.
      4. Hangers and supports, including methods for duct and building attachment and vibration isolation.

1.04 WARRANTY
   A. Provide 2 year warranty for all VAV boxes to include parts, installation and labor.

1.05 INFORMATIONAL SUBMITTALS
   A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
      1. Ceiling suspension assembly members.
      2. Size and location of initial access modules for acoustic tile.
      3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
   B. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals.
      1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
         a. Instructions for resetting minimum and maximum air volumes.
         b. Instructions for adjusting software set points.

PART 2 PRODUCTS

2.01 SYSTEM DESCRIPTION
   A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   B. ASHRAE Compliance: Applicable requirements in ASHRAE/IES 90.1, "Section 6 - Heating, Ventilating, and Air Conditioning."
2.02 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Anemostat Products; a Mestek company.
   2. Carnes Company.
   3. ENVIRO-TEC; by Johnson Controls, Inc.
   5. Nailor Industries Inc.
   7. Titus.

B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

C. Casing: 22 gauge galvanized steel, single wall.
   2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
   3. Air Outlet: S-slip and drive connections.
   4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.

D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
   1. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.

E. Hydronic Heating Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.

2.03 CASING LINER

A. Casing Liner: Fibrous-glass duct liner, complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Minimum Thickness: 1/2 inch for standard VAV and 1" for fan powered VAV boxes.
      a. Maximum Thermal Conductivity:
         b. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
   2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
   3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

PART 3 EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 5, "Hangers and Supports" and with Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.
   2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches thick.
   4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.
D. 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.

3.02 TERMINAL UNIT INSTALLATION
A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

3.03 CONNECTIONS
A. Where installing piping adjacent to air terminal unit, allow space for service and maintenance.
B. Hot-Water Piping: Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties," and connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.
C. Comply with requirements in Section 233113 "Metal Ducts" for connecting ducts to air terminal units.
D. Make connections to air terminal units with flexible connectors complying with requirements in Section 233300 "Air Duct Accessories."

3.04 IDENTIFICATION
A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.05 FIELD QUALITY CONTROL
A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
   2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
B. Air terminal unit will be considered defective if it does not pass tests and inspections.
C. Prepare test and inspection reports.

3.06 STARTUP SERVICE
A. Perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
   3. Verify that controls and control enclosure are accessible.
   4. Verify that control connections are complete.
   5. Verify that nameplate and identification tag are visible.
   6. Verify that controls respond to inputs as specified.

3.07 DEMONSTRATION
A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 23 36 00
SECTION 23 37 13
DIFFUSERS, REGISTERS, AND GRILLES

PART 1 GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Grilles, Registers, Diffusers
B. Related Sections:
   1. Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.03 ACTION SUBMITTALS
A. Product Data: For each type of product indicated, include the following:
   1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
   2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 PRODUCTS

2.01 GRILLES, REGISTERS, DIFFUSERS
A. Grilles, Registers, Diffusers:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      b. Amneostat
      c. Carnes.
      d. Hart & Cooley Inc.
      e. Krueger.
      f. Nailor Industries Inc.
      g. Price Industries.
      h. Titus.
      i. Tuttle & Bailey.

2.02 SOURCE QUALITY CONTROL
A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 EXECUTION

3.01 EXAMINATION
A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

3.02 INSTALLATION
A. Install diffusers, registers, and grilles level and plumb.
B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.03 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Factory-assembled packaged chiller.
B. Charge of refrigerant and oil.
C. Controls and control connections.
D. Chilled water connections.
E. Electrical power connections.

1.02 RELATED REQUIREMENTS
A. Section 03 30 00 - Cast-in-Place Concrete: Concrete housekeeping pads.
B. Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
C. Section 23 05 53 - Identification for HVAC Piping and Equipment.
D. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.
E. Section 23 08 00 - Commissioning of HVAC.
F. Section 23 09 23 - Direct-Digital Control System for HVAC.
G. Section 23 09 93 - Sequence of Operations for HVAC Controls.
H. Section 23 21 13 - Hydronic Piping.
I. Section 23 21 14 - Hydronic Specialties.
J. Section 26 05 83 - Wiring Connections.

1.03 REFERENCE STANDARDS
C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2018.

1.04 ADMINISTRATIVE REQUIREMENTS
A. Coordination: Coordinate physical size, weight and location of major pieces of equipment to be installed. Notify Architect of any major deviations from the equipment originally specified prior to ordering equipment.

1.05 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.
C. Shop Drawings: Indicate components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate equipment, piping and connections, valves, strainers, and thermostatic valves required for complete system.
D. Manufacturer’s Performance Data: Indicate energy input versus cooling load output from 0 to 100 percent of full load at specified and minimum condenser water temperature for water-cooled chillers and at specified and minimum outdoor air temperature for air-cooled chillers.
E. Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories; include trouble-shooting guide.

F. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE
A. When required, provide certification of inspection in compliance with the requirements of Authority Having Jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING
A. Comply with manufacturer's written installation instructions for rigging, unloading, and transporting units.
B. Deliver units to the job site completely assembled and charged with refrigerant and oil by manufacturer.

1.08 WARRANTY
A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
B. Manufacturer's Warranty: Provide minimum five year warranty to include coverage for materials and labor for compressor.

PART 2 PRODUCTS
2.01 MANUFACTURERS
B. Trane, a brand of Ingersoll Rand: www.trane.com/#sle.
D. Substitutions: See Section 01 60 00 - Product Requirements.
   1. The chilled water system has been designed based on specific capacities and characteristics of equipment specified in this section and other sections.

2.02 CHILLERS
A. Chillers: Factory assemble and test chiller consisting of compressor(s), compressor motor(s), evaporator, condenser, enclosure, refrigeration circuits(s) and specialties, interconnecting piping, starters, and microprocessor-based controls.
   1. Special Features and Options:
      a. Packaged buffer tank and chiller primary circulation pumps.
   5. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. or testing firm acceptable to the Authority Having Jurisdiction as suitable for the purpose specified and indicated.
   6. Energy Efficiency: ASHRAE Std 90.1 I-P.
   7. Enclosures:
      a. Frame:
         1) Heavy-gage steel.
         2) Factory apply hot-dipped galvanized or air-dried paint finish.
      b. Steel Chiller Cabinets:
         1) Factory apply baked on enamel or baked on powder paint finish.
      c. Electrical Equipment: NEMA 250 or UL 1995 as applicable.

2.03 COMPRESSORS AND EVAPORATOR
A. Compressors: Hermetic scroll type.
   1. Unit: Fully hermetic type with multiple, direct drive compressors with discharge and suction service valves.
2. Vibration Control: Factory installed internal isolators or field installed external isolators.
3. Oil Lubrication System: Initial oil charge, oil sump, heater, oil level, and sight glass.
4. Capacity Reduction System: Compressor staging with control down to 12 percent of full load without the activation of hot gas by-bass.

B. Evaporator: Provide brazed plate type.
   1. Brazed plate type.
      a. Plate Material: 316 stainless steel.
      b. Refrigerant Working-Side Pressure Rating: 430 psig minimum.
      d. Provide with flanged or grooved connections.
      e. Insulation for all cold surfaces.
         1) Insulation is factory or field installed on evaporator, connections, suction piping, and buffer tank.
         2) 0.75 inches minimum thick, closed cell, expanded polyvinyl chloride, polyurethane, or Armaflex II insulation with a maximum k value of 0.28.
      f. Provide factory or field installed vents and water drain connections on evaporator or piping.
      g. Provide factory installed fittings for temperature control sensors on evaporator or piping.
      h. Freeze Protection for Outdoor Locations: Provide thermostatically controlled electric heater to protect from freezing at ambient temperatures down to minus 20 degrees F.

2.04 AIR-COOLED CONDENSER AND FANS
A. Provide brazed one-piece or flat tube-plate-manifold type.
   1. Brazed one-piece type.
      a. Construct of same material to avoid galvanic corrosion.
      b. Braze coils and headers as one assembly.
      c. Clean, dehydrate and test.
      d. Leak Test: 650 psig minimum.
   2. Flat tube-plate-manifold type.
      a. Construct all components of same aluminum alloy to avoid galvanic corrosion.
      b. Braze manifolds, flat tubes and fin-plates together to form single coil assembly.
      c. Clean, dehydrate and test.
      d. Leak Test: 656 psig minimum.

B. Coil Guards: Provide corrosion proof, louvered panels, heavy gage wire panels, or grilles, factory installed. Provide coil protection for shipping by enclosing entire condenser coil with heavy plastic to prevent coil damage during shipping or rigging.

C. Fans and Motors:
   1. Fans: Dynamically balance propeller, shrouded-axial, or airfoil type fans of reinforced polymer or glass fiber reinforced composite corrosion resistant construction equipped with sealed, permanently lubricated ball bearings.
   2. Discharge Fan Guards: Corrosion resistant, heavy gage, steel wire.
   4. Motors: Direct drive, totally enclosed for outdoor use with current overload protection.

2.05 REFRIGERATION CIRCUITS
A. Provide multiple independent refrigeration circuit(s) with multiple, one, or 3 compressor(s) per circuit.

B. Provide liquid line shut-off valve, filter-drier, expansion valve, and refrigerant relief device for each independent circuit.

2.06 INTEGRATED MICROPROCESSOR BASED DDC CONTROLS PACKAGE
A. Pre-wire, assemble, factory mount, and test operating and safety control system consisting of a digital display or gages, on-auto-off switch, motor starters, disconnect switches, power and
control wiring. Provide controls, monitoring, programmable set-points, alarms, and BAS as defined below:

1. Automatic Adjustable Operating Controls:
   a. Allow system start-up and system operation at all outdoor air temperatures down to 40 degrees F.
   b. Temperature of chilled water leaving chiller.
   c. Chiller system capacity control based on set-points and system load.
   d. Compressor short-cycling prevention.
   e. Lead/lag for multiple compressors.
   f. Automatic reset on power source failure.
   g. Load limiting.
   h. Sequencing of condenser fans.

2. Normal Operation Monitoring and Open Cover-less Displays:
   a. Hours of operation.
   b. Suction and discharge refrigerant pressures.
   c. Automatic diagnostics.
   d. Number of starts.
   e. On/off compressor status.
   f. Entering and leaving chilled water temperatures.
   g. Status of operation.
   h. Weekly purge cycle totalization if applicable.
   i. Oil pressure.

3. Set-Points:
   a. Leaving chilled water temperature.
   b. Date/time.

4. Automatic Chiller Shut-Down Safety Controls and Alarm:
   a. Automatic Reset:
      1) Chilled water flow interlock.
      2) Voltage protection (over/under).
      3) Phase reversal protection.
   b. Manual Reset:
      1) Evaporator low pressure.
      2) High motor winding temperature.
      3) Low chilled water temperature.
      4) Low chilled water flow.
      5) High condenser refrigerant discharge pressure.
      6) Motor current overload and phase loss.
      7) Low oil flow.

5. Building Automation System (BAS) Communications via Shielded Cable:
   a. Minimum Data Transmission to BAS:
      1) All system operating conditions.
      2) Capacity control information.
      3) Safety shutdown conditions.
   b. Minimum Operating Commands from BAS:
      1) Remote unit start/stop.
      2) Remote chilled water reset.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Align chiller package on steel or concrete foundations.
C. Install units on vibration isolators.
D. Connect to electrical service.
E. Connect to chilled water piping.
F. Arrange piping for easy dismantling to permit tube cleaning and removal.

3.02 MANUFACTURER'S FIELD SERVICES
A. Perform factory startup of the chiller by factory trained and authorized servicing technicians confirming equipment has been correctly installed prior to equipment becoming operational and covered under the manufacturer's warranty.
B. Supply initial charge of refrigerant and oil if not completely factory charged.
C. Demonstrate system operations and verify specified performance.

3.03 CLOSEOUT ACTIVITIES
A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
B. See Section 01 79 00 - Demonstration and Training, for additional requirements.
C. Demonstrate proper operation of equipment to Owner's designated representative.
D. Demonstration: Demonstrate operation of system to Owner's personnel.
   1. Use operation and maintenance data as reference during demonstration.
   2. Briefly describe function, operation, and maintenance of each component.
E. Training: Train Owner's personnel on operation and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two hours of training.
   3. Instructor: Manufacturer's training personnel.
   4. Location: At project site.

END OF SECTION 23 64 23
SECTION 23 65 00
COOLING TOWERS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Open-circuit, induced-draft, counter-flow cooling towers.

1.02 RELATED REQUIREMENTS
A. Section 22 05 13 - Common Motor Requirements for Plumbing Equipment.
B. Section 22 10 05 - Plumbing Piping.
C. Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
D. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.
E. Section 23 21 13 - Hydronic Piping.
F. Section 23 21 23 - Hydronic Pumps.
G. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide rated capacities, dimensions, weights and point loadings, accessories, required clearances, electrical requirements and wiring diagrams, and location and size of field connections. Submit schematic indicating capacity controls.
C. Shop Drawings: Indicate suggested structural steel supports including dimensions, sizes, and locations for mounting bolt holes.
D. Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories.
E. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.04 REGULATORY REQUIREMENTS
A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.05 DELIVERY, STORAGE, AND HANDLING
A. Factory assemble entire unit. For shipping, disassemble into as large as practical sub-assemblies so that minimum amount of field work is required for re-assembly.
B. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

1.06 WARRANTY
A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
B. Provide a one year warranty to include coverage for defects in material and workmanship labor only.
C. Fans, fan shafts, bearings, sheaves, gearboxes, drive shafts, couplings, and mechanical equipment support must be warranted against defects in materials and workmanship for a period of five (5) years; or seven (7) if motor space heater is properly wired.
D. Fans, fan shafts, bearings, sheaves, gearboxes, drive shafts, couplings, and mechanical equipment support must be warranted against defects in materials and workmanship for a period of seven (7) with EnduraDrive Fan System from date of shipment.
PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

2.02 PERFORMANCE REQUIREMENTS

A. SCOPE

1. Work included to furnish and install two (2) Delta Anti-Microbial Paragon Model Cooling Towers, one (1) model DT100iAM and one (1) DT125iAM consisting of all equipment necessary to provide a complete operating system to remove specified heat load. Cooling towers shall be packaged, factory pre-assembled to the fullest extent possible, induced draft, counter flow design. The towers should be delivered with the following accessories:

- Alluminum Ladder and Cage w/ 2' ladder extension
- Vibration cut-off Switch
- VFD for Fan Drives
- Outlet Strainer
- Equalizer Fittings
- Bottom Outlet
- Mounting Platform
- Air Louver Filter mesh
- BAS Interface

B. WARRANTY

1. Shell shall be warranted for 20 years and all other equipment shall be warranted for one year against material and workmanship defects from date of shipment.

C. PART 2 PRODUCT

1. Induced Draft Cooling Towers, One (1) Model DT100iAM, 100 tons capacity, 250 GPM, 95 °F hot water temperature, 85 °F cold water temperature, 79 °F wet bulb temperature and One (1) Model DT125iAM, 125 tons capacity, 316 GPM, 95 °F hot water temperature, 85 °F cold water temperature, 79 °F wet bulb temperature

a. Cooling tower

1) Shell shall be seamless, non-corrosive, hi-impact high density polyethylene (HDPE) of leak proof design. Conical transition for motor/fan assembly and 360° louvered air inlet panels around base of cooling tower integrated for optimum air distribution. The shell shall exceed 1/4" average thickness. The structural shell shall be capable of withstanding water temperatures up to 160°F on a continual basis.

2) Sump shall be integral with cooling tower shell, creating a one-piece seamless structure.

3) Cooling tower structural shell shall be guaranteed against corrosion for 20 years.

4) Removable PVC louver located above the integral cold sump for accessibility to automatic make-up valve and adjustable float.

b. PVC fittings shall be provided for inlet, outlet, overflow, drain and make up.

1) Outlet fitting for pump suction applications shall be provided with a vortex breaker.

2) Make up assembly shall be incorporated in the sump of the cooling tower. It shall be a mechanical valve assembly, adjustable height for varying operating condition.

3) Anti-Microbial Materials of Construction

4) 8.1 Tower Shell Materials: Tower Shell to have compounded additive in resin base material that creates anti-microbial properties throughout the cross-section of the shell material. Anti-microbial properties of the Shell material shall be tested in accordance with Efficacy Standard JIS Z 2801 and produce an anti-microbial activity value of greater than R=4 as displayed by the test results. The purpose of this option is to minimize Bio film growth in the tower and significantly reduce the possibility of Legionella growth within the tower.
5) 8.2 Tower Fill Materials: Tower shall include Wet Decking (fill) with similar antimicrobial efficacy to the tower shell. The Wet Decking shall have an additive in the fill base material that inhibits the growth of microorganisms and resists the growth of biofilms. Anti-microbial properties of the Wet Decking shall be tested in accordance with Efficacy Standard JIS Z 2801 and produce an anti-microbial activity value of greater than R=4 as displayed by the test results. This fill selection is included with the antimicrobial shell upgrade detailed in item 8.1.

D. The engineered plastic shell is the optimum material for cooling tower construction. The material is molded into a totally seamless shell which will never leak, unlike conventional cooling towers which require many panels, joints, seams, seam gaskets, caulking and hundreds of bolts or other fasteners to maintain the integrity of the product. The Delta structural shell will never rust, chip, crack or ever need painting or further protective coatings. The structural shell is warranted for 20 years which is much longer than other available cooling towers.

E. Galvanized steel towers provide only interim corrosion protection. The zinc galvanizing is designed only to delay corrosion as the zinc wears steadily away. Moderately high temperatures and various water chemical treatments speed up this leaching of zinc into the water or atmosphere. With only ounces per square foot of corrosion protection, it is only a matter of time till corrosion of the underlying sheet steel sets in.

F. Thin fiberglass panels can also not match the structural integrity of Deltas’ seamless engineered plastic. Over time, if that long, leaks can develop at the joints even with gaskets and caulking applied. Thin fiberglass when exposed to the wide range of outdoor weather elements is also subject to delaminating, wicking and overall degradation.

G. Drift eliminator
   1. Shall be non-corrosive polyethylene integral with rotating water distribution system
      a. Water distribution
         1) Self propelled PVC distribution system incorporating a rotating sprinkler head and lateral distribution arms with integral drift eliminators. An access port shall be provided in cooling tower shell at lateral arm elevation for access to removable end caps for ease of maintenance.
      b. Wet decking
         1) Continuously wrapped spiral configuration of lightweight polyvinyl chloride PVC, bonded for maximum cooling efficiency.
      c. Fan assembly
         1) Fan propeller shall be adjustable pitch direct drive. Fan blades shall be constructed of fiberglass reinforced polypropylene with aluminum silicon alloy hub with stainless steel hardware; statically and dynamically balanced prior to shipping.
            (a) Fan and motor shall be supported by heavy gauge rolled steel ring. The fan ring shall be coated with a premium Plastisol for corrosion protection.
            (b) Motors shall be Direct Drive, Totally Enclosed, Energy Efficient, 1200 RPM, Inverter Rated, with Double Sealed Bearings, Corrosion Resistant Mill & Chemical Duty Paint and designed for cooling tower duty.
            (c) Motor shall be provided with motor manufactures standard warranty.

H. Propeller type fan is attached to the shaft of the motor. The direct drive system has a twofold benefit. First and foremost, there are no extra bearings, pulleys, gear reducers or additional shafts to maintain or fail. The second benefit is the higher efficiency gained by connecting the motor to the motor shaft, there are no losses due to friction from bearings and gears, thus providing the highest efficiency available.
   1. Fan guard shall be coated steel mesh, 1/2” open area to allow air to pass through with minimal pressure loss while protecting personnel from contacting the rotating fan propeller.
      a. Hardware
         1) All fasteners are 304SS. Anchor and lifting lugs are aluminum.
PART 3 EXECUTION

3.01 INSTALLATION
   A. Install in accordance with manufacturer's instructions.
   B. Install tower on structural steel beams as instructed by manufacturer.
   C. Connect condenser water piping with flanged connections to tower. Pitch condenser water supply to tower and condenser water suction away from tower. Refer to Section 23 21 13.
   D. Connect make-up water piping with flanged or union connections to tower. Pitch to tower. Refer to Section 22 10 05.

3.02 FIELD QUALITY CONTROL
   A. See Section 01 40 00 - Quality Requirements, for additional requirements.
   B. Provide the services of the manufacturer's field representative to inspect tower after installation and submit report prior to start-up, verifying installation is in accordance with specifications and manufacturer's recommendations.

3.03 SYSTEM STARTUP
   A. Start-up tower in presence of and instruct Owner's operating personnel.

   END OF SECTION 23 65 00
SECTION 23 73 13
MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 GENERAL

1.01 WORK INCLUDED
   A. Applied Air Handling Units. (All indoor air handling units except AHU-5)

1.02 RELATED SECTIONS
   A. Section 15751 - Glycol System.
   B. Section 15900 - Building Automation and Control Systems
   C. Section 15950 - Controls and Instrumentation.
   D. Section 16180 - Equipment Wiring Systems: Electrical supply to units.
   E. Section 01513 - Temporary Heating, Cooling, and Ventilating.
   F. Section 15121 - Expansion Compensation.
   G. Section 15290 - Duct Work Insulation.

1.03 REFERENCES
   B. AMCA Publication 611 - Certified Ratings Program - Airflow Measurement Performance
   C. AMCA Standard 500-D - Laboratory Methods of Testing Dampers for Rating.
   D. ANSI/ABMA Standard 9 - Load Ratings and Fatigue Life for Ball Bearings.
   E. ANSI/AMCA Standard 204 - Balance Quality and Vibration Levels for Fans.
   H. ANSI/AHRI Standard 430 - Central Station Air Handling Units.
   M. ANSI/NEMA MG 1 - Motors and Generators.
   N. ANSI/UL 900 - Standard for Safety Air Filter Units.
   V. NFPA 70 - National Electrical Code
X. UL 1995 - Standard for Safety Heating and Cooling Equipment

1.04 QUALITY ASSURANCE

A. Air Coils: Certify capacities, pressure drops and selection procedures in accordance with current AHRI Standard 410.

B. Air handling units with fan sections utilizing single fans shall be rated and certified in accordance with AHRI Standard.

C. Air handling units with fan sections utilizing multiple fans shall be rated in accordance with AHRI Standard 430 for airflow, static pressure, and fan speed performance.

D. Airflow monitoring station: Certify airflow measurement station performance in accordance with AMCA 611.

E. ISO 9001 Certification.

1.05 SUBMITTALS

A. No equipment shall be fabricated or delivered until the receipt of approved shop drawings from the Owner or Owner's approved representative.

B. AHU manufacturer shall provide the following information with each shop drawing/product data submission:

1. Dimensioned arrangement drawings for each AHU including a plan and elevation view of the assembled unit with overall dimensions, lift points, unit shipping split locations and dimensions, installation and operating weights, and installation, operation and service clearances.

2. All electrical, piping, and ductwork requirements, including sizes, connection locations, and connection method recommendations.

3. Each component of the unit shall be identified and mechanical specifications shall be provided for unit and accessories describing construction, components, and options.

4. All performance data, including capacities and airside and waterside pressure drops, for components.

5. Fan curves shall be provided for fans with the design operating points indicated. Data shall be corrected to actual operating conditions, temperatures, and altitudes.

6. For units utilizing multiple fans in a fan section, a fan curve shall be provided showing the performance of the entire bank of fans at design conditions. In addition, a fan curve shall be provided showing the performance of each individual fan in the bank of fans at design conditions. Also a fan curve shall be provided showing the performance of the bank of fans, if one fan is down. The percent redundancy of the bank of fans with one fan down shall be noted on the fan curve or in the tabulated fan data.

7. A filter schedule must be provided for each air handling unit supplied by the air handling unit manufacturer. Schedule shall detail unit tag, unit size, corresponding filter section location within the AHU, filter arrangement (e.g. angled/flat), filter depth, filter type (e.g. pleated media), MERV rating, and filter quantity and size.

8. A schedule detailing necessary trap height shall be provided for each air handling unit. Schedule shall detail unit tag, unit size, appropriate trap schematic with recommended trap dimensions, and unit supplied base rail height. Contractor shall be responsible for additional trap height required for trapping and insulation beyond the unit supplied base rail height by adequate housekeeping pad.

9. A coil valve coordination schedule shall be provided for each air handling unit supplied by the air handling unit manufacturer. Schedule shall detail unit tag, coil type and corresponding section location within the AHU, valve style (e.g. global, ball), valve type (e.g. electronic 2-way/3-way), valve position (e.g. normally open/closed), size, flow coefficient (CV), and close-off pressure.

10. An electrical MCA - MOP schedule shall be provided for each electrical circuit to which field-power must be supplied. Schedule to detail unit tag, circuit description, voltage/phase/hertz, Minimum Circuit Ampacity (MCA), and calculated Maximum Overcurrent Protection (MOP).
11. Sound data shall be provided using AHRI 260 test methods. Unit discharge, inlet, and radiated sound power levels in dB shall be provided for 63, 125, 250, 500, 1000, 2000, 4000 and 8000Hz.

C. The AHU manufacturer shall provide appropriate sets of submittals as referenced in the General Conditions and shall submit to the Owner electronic copies of the IOM.

D. The AHU manufacturer shall list any exceptions to the specification.

1.06 REGULATOR REQUIREMENTS

A. Agency Listings/Certifications

1. Unit shall be manufactured to conform to UL 1995 and shall be listed by either UL/CUL or ETL. Units shall be provided with listing agency label affixed to the unit. In the event the unit is not UL/CUL or ETL approved, the contractor shall, at his/her expense, provide for a field inspection by a UL/CUL or ETL representative to verify conformance. If necessary, contractor shall perform modifications to the unit to comply with UL/CUL or ETL as directed by the representative, at no additional expense to the owner.

2. Air handling units with multiple direct drive plenum fans, or direct drive plenum fans incorporated with ECM style motors are outside the scope of AHRI 430. These fans however are rated in accordance with AHRI 430.

3. Certify air handling units in accordance with AHRI Standard 430. Units shall be provided with certification label affixed to the unit. If air handling units are not certified or fans are not rated in accordance with AHRI Standard 430 contractor shall be responsible for expenses associated with testing of units after installation to verify performance of fan(s). Any costs incurred to adjust fans to meet scheduled capacities shall be the sole responsibility of the contractor.

4. Certify air handling coils in accordance with AHRI Standard 410. Units shall be provided with certification label affixed to the unit. If air handling coils are not certified in accordance with AHRI Standard 410, contractor shall be responsible for expenses associated with testing of coils after installation to verify performance of coil(s). Any costs incurred to adjust coils to meet scheduled capacities shall be the sole responsibility of the contractor.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

B. Units shall ship fully assembled up to practical shipping and rigging limitations. Units not shipped fully assembled shall have tags and airflow arrows on each section to indicate location and orientation in direction of airflow. Shipping splits shall be clearly defined on submittal drawings. Cost associated with non-conformance to shop drawings shall be the responsibility of the manufacturer. Each section shall have lifting lugs for field rigging, lifting and final placement of AHU section(s). AHU's less than 100-inches wide shall allow for forklift transport and maneuverability on the jobsite.

C. Deliver units to jobsite with fan motor(s), sheave(s), and belt(s) completely assembled and mounted in units.

D. Unit shall be shipped in a clear shrink-wrap or stretch-wrap to protect unit from in-transit rain and debris per ASHRAE 62.1 recommendations.

E. Installing contractor shall be responsible for storing AHU in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.08 START-UP AND OPERATING REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters in place, bearings lubricated (if applicable), condensate properly trapped, piping connections verified and leak-tested, belts aligned and tensioned, all shipping braces removed, bearing set screws torqued, and fan has been test run under observation.
1.09 WARRANTY

A. AHU manufacturer shall provide, at no additional cost, a standard parts warranty that covers a period of one year from unit start-up or 18 months from shipment, whichever occurs first. This warrants that all products are free from defects in material and workmanship and shall meet the capacities and ratings set forth in the equipment manufacturer's catalog and bulletins.

PART 2 PRODUCTS

ACCEPTABLE MANUFACTURERS

A. Approved manufacturer shall be Trane, with pre-approved alternates considered. Manufacturers not pre-approved, must obtain pre-approval in writing from consulting engineer prior to bid day. Alternates must comply with all performance and features as called for in this specification. Job awarded on basis of specified equipment. Alternate will be evaluated and considered after job is awarded.

B. Manufacturer must clearly define any exceptions made to Plans and Specifications. Any deviations in layout or arrangement shall be submitted to consulting engineer prior to bid date. Acceptance of deviation(s) from specifications shall be in the form of written approval from the consulting engineer. Mechanical Contractor is responsible for expenses that occur due to exceptions made.

C. Approved Manufacturers:
   1. Trane Performance Climate Changer
   2. York Solution XT High Performance
   3. Daikin McQuay Vision Custom

2.01 GENERAL

A. Unit layout and configuration shall be as defined in project plans and schedule.

B. Manufacturer to provide a full perimeter integral base frame for either ceiling suspension of units or to support and raise all sections of the unit for proper trapping. Base frame will either be bolted construction or welded construction. Refer to schedule for base height and construction type. Contractor will be responsible for providing a housekeeping pad when unit base frame is not of sufficient height to properly trap unit. Unit base frames not constructed of galvanized steel shall be chemically cleaned and coated with both a rust-inhibiting primer and finished coat of rust-inhibiting enamel. Unit base height to be included in total height required for proper trap height.

2.02 UNIT CASING

A. Unit manufacturer shall ship unit in segments as specified by the contractor for ease of installation in tight spaces. The entire air handler shall be constructed of galvanized steel. Casing finished to meet ASTM B117 250-hour salt-spray test. The removal of access panels or access doors shall not affect the structural integrity of the unit. All removable panels shall be gasketed. All doors shall have gasketing around full perimeter to prevent air leakage. Contractor shall be responsible to provide connection flanges and all other framework that is needed to properly support the unit.

B. Casing performance - Casing air leakage shall not exceed 1% of design airflow at the specified casing pressure.

C. Air leakage shall be determined at 1.00 times maximum casing static pressure up to 8 inches w.g. Specified air leakage shall be accomplished without the use of caulk. Total estimated air leakage shall be reported for each unit in CFM, as a percentage of supply air, and as an ASHRAE 111 Leakage Class.

D. Under 55F supply air temperature and design conditions on the exterior of the unit of 81F dry bulb and 73F wet bulb, condensation shall not form on the casing exterior. The AHU manufacturer shall provide tested casing thermal performance for the scheduled supply air temperature plotted on a psychrometric chart. The design condition on the exterior of the unit shall also be plotted on the chart. If tested casing thermal data is not available, AHU manufacturer shall provide, in writing to the Engineer and Owner, a guarantee against
condensation forming on the unit exterior at the stated design conditions above. The guarantee shall note that the AHU manufacturer will cover all expenses associated with modifying units in the field should external condensate form on them. In lieu of AHU manufacturer providing a written guarantee, the installing contractor must provide additional external insulation on AHU to prevent condensation.

E. Unit casing (wall/floor/roof panels and doors) shall be able to withstand up to 1.5 times design static pressure, or 8-inch w.g., whichever is less, and shall not exceed 0.0042 per inch of panel span (L/240).

F. Floor panels shall be double-wall construction and designed to support a 300-lb load during maintenance activities and shall deflect no more than 0.0042 per inch of panel span.

G. Unit casing panels shall be 2-inch double-wall construction, with solid galvanized exterior and solid galvanized interior, to facilitate cleaning of unit interior.

H. Unit casing panels (roof, walls, floor) and doors shall be provided with a minimum thermal resistance (R-value) of 13 Hr*Ft²°F/BTU.

I. Unit casing panels (roof, walls, floor) and external structural frame members shall be completely insulated filling the entire panel cavity in all directions so that no voids exist. Panel insulation shall comply with NFPA 90A.

J. Casing panel inner liners must not extend to the exterior of the unit or contact the exterior frame. A mid-span, no-through-metal, internal thermal break shall be provided for all unit casing panels.

K. Access panels and/or access doors shall be provided in all sections to allow easy access to drain pan, coil(s), motor, drive components and bearings for cleaning, inspection, and maintenance.

L. Access panels and doors shall be fully removable without the use of specialized tools to allow complete access of interior surfaces.

2.03 ACCESS DOORS

A. Access doors shall be 2-inch double-wall construction. Interior and exterior shall be of the same construction as the interior and exterior wall panels.

B. All doors shall be provided with a thermal break construction of door panel and door frame.

C. Gasketing shall be provided around the full perimeter of the doors to prevent air leakage.

D. Door hardware shall be surface-mounted to prevent through-cabinet penetrations that could likely weaken the casing leakage and thermal performance.

E. Handle hardware shall be designed to prevent unintended closure.

F. Access doors shall be hinged and removable without the use of specialized tools.

G. Hinges shall be interchangeable with the door handle hardware to allow for alternating door swing in the field to minimize access interference due to unforeseen job site obstructions. Hinges shall be constructed of

H. Door handle hardware shall be adjustable and visually indicate locking position of door latch external to the section.

I. All doors shall be a 60-inch high when sufficient unit height is available, or the maximum height allowed by the unit height.

J. Multiple door handles shall be provided for each latching point of the door necessary to maintain the specified air

2.04 PRIMARY DRAIN PANS

A. All cooling coil sections shall be provided with an insulated, double-wall, Stainless steel drain pan.

B. The drain pan shall be designed in accordance with ASHRAE 62.1 being of sufficient size to collect all condensation produced from the coil and sloped in two planes, pitched toward drain connections, promoting positive drainage to eliminate stagnant water conditions when unit is
installed level and trapped per manufacturer's requirements. See section 2.07, paragraph F through H for specifications on intermediate drain pans between cooling coils.

C. The outlet shall be located at the lowest point of the pan and shall be sufficient diameter to preclude drain pan overflow under any normally expected operating condition.

D. All drain pan threaded connections shall be visible external to the unit. Threaded connections under the unit floor shall not be accepted.

E. Drain connections shall be of the same material as the primary drain pan and shall extend a minimum 2-1/2-inch beyond the base to ensure adequate room for field piping of condensate traps.

F. The installing contractor is responsible to ensure the unit is installed level, trapped in accordance with the manufacturer's requirements, and visually inspected to ensure proper drainage of condensate.

G. Coil support members inside the drain pan shall be of the same material as the drain pan and coil casing.

H. If drain pans are required for heating coils, access sections, or mixing sections they will be indicated in the plans.

2.05 FANS

A. Fan sections shall have a minimum of one hinged and latched access door located on the drive side of the unit to allow inspection and maintenance of the fan, motor, and drive components. Construct door(s) per Section 2.04.

B. Provide fans of type and class as specified on the schedule. Fan shafts shall be solid steel, coated with a rust-inhibiting coating, and properly designed so that fan shaft does not pass through first critical speed as unit comes up to rated RPM. All fans shall be statically and dynamically tested by the manufacturer for vibration and alignment as an assembly at the operating RPM to meet design specifications. Fans that are selected with inverter balancing shall first be dynamically balanced at design RPM. The fans then will be checked in the factory from 25% to 100% of design RPM to insure they are operating within vibration tolerance specifications, and that there are no resonant frequency issues throughout this operating range. Inverter balancing that requires lockout frequencies inputted into a variable frequency drive to in order to bypass resonant frequencies shall not be acceptable. If supplied in this manner by the unit manufacturer, the contractor will be responsible for rebalancing in the field after unit installation. Fans selected with inverter balancing shall have a maintenance free, circumferential conductive micro fiber shaft grounding ring installed on the fan motor to discharge shaft currents to ground.

C. Direct drive plenum fans with integral frame motors, shall be rigid mounted. Fan shall be dynamically balanced throughout the operating range to a BV-3 (0.15 in/s) per AMCA 204 test standard. Internally-mounted motor shall be on the same fan base. A flexible connection shall be installed between fan and unit casing to ensure complete isolation. Flexible connection shall comply with NFPA 90A and UL 181 requirements.

D. MOTORS AND DRIVES

1. All motors and drives shall be factory-installed and run tested. All motors shall be installed on a slide base to permit adjustment of belt tension. Slide base shall be designed to accept all motor sizes offered by the air-handler manufacturer for that fan size to allow a motor change in the future, should airflow requirements change. Fan sections without factory-installed motors shall have motors field installed by the contractor. The contractor shall be responsible for all costs associated with installation of motor and drive, alignment of sheaves and belts, run testing of the motor, and balancing of the assembly.

2. Motors shall meet or exceed all NEMA Standards Publication MG 1 - 2006 requirements and comply with NEMA Premium efficiency levels when applicable. Motors shall comply with applicable requirements of NEC and shall be UL Listed.

3. Fan Motors shall be heavy duty, open drip-proof operable at 460 volts, 60Hz, 3-phase. If applicable, motor efficiency shall meet or exceed NEMA Premium efficiencies.
4. Belt driven fans shall use 4-pole, 1800 rpm, motors, NEMA B design, with Class B insulation, capable to operate continuously at 104 deg F (40 deg C) without tripping overloads.

5. Direct driven fans utilizing integral frame motors shall use 2-pole (3600 rpm), 4-pole (1800 rpm) or 6-pole (1200 rpm) motors, NEMA Design B, with Class B insulation capable to operate continuously at 104 deg F (40 deg C) without tripping overloads.

6. Motors shall have a +/- 10 percent voltage utilization range to protect against voltage variation.

2.06 COILS

A. Coils section header end panel shall be removable to allow for removal and replacement of coils without impacting the structural integrity of the unit.

B. Install coils such that headers and return bends are enclosed by unit casing to ensure that if condensate forms on the header or return bends, it is captured by the drain pan under the coil.

C. Coils shall be manufactured with plate fins to minimize water carryover and maximize airside thermal efficiency. Fin tube holes shall have drawn and belled collars to maintain consistent fin spacing to ensure performance and air pressure drop across the coil as scheduled. Tubes shall be mechanically expanded and bonded to fin collars for maximum thermal conductivity. Use of soldering or tinning during the fin-to-tube bonding process is not acceptable due to the inherent thermal stress and possible loss of bonding at that joint.

D. Construct coil casings of galvanized steel. End supports and tube sheets shall have belled tube holes to minimize wear of the tube wall during thermal expansion and contraction of the tube.

E. All coils shall be completely cleaned prior to installation into the air handling unit. Complete fin bundle in direction of airflow shall be degreased and steam cleaned to remove any lubricants used in the manufacturing of the fins, or dirt that may have accumulated, in order to minimize the chance for water carryover.

F. When two or more cooling coils are stacked in the unit, an intermediate drain pan shall be installed between each coil. The intermediate drain pan shall be designed being of sufficient size to collect all condensation produced from the coil and sloped to promote positive drainage to eliminate stagnant water conditions. The intermediate drain pan shall be constructed of the same material as the sections primary drain pan.

G. The intermediate drain pan shall begin at the leading face of the water-producing device and be of sufficient length extending downstream to prevent condensate from passing through the air stream of the lower coil.

H. Intermediate drain pan shall include downspouts to direct condensate to the primary drain pan. The intermediate drain pan outlet shall be located at the lowest point of the pan and shall be sufficient diameter to preclude drain pan overflow under any normally expected operating condition.

I. Coil shall have a flexible epoxy polymer e-coat uniformly applied to all coil surface areas without material bridging between fins. Coating process shall ensure complete coil encapsulation and a uniform dry film thickness from 0.8 to 1.2 mil on all surface areas including fin edges. Corrosion durability shall be confirmed through testing to no less than 5,000 hours salt spray per ASTM B117.

J. Hydronic Coils

1. Supply and return header connections shall be clearly labeled on unit exterior such that direction of coil water-flow is counter to direction of unit air-flow.

2. Coils shall be proof-tested to 300 psig and leak-tested to 200 psig air pressure under water.

3. Headers shall be constructed of round copper pipe or cast iron.

4. Tubes shall be 1/2-inch .016 copper, with aluminum fins.

5. Hydronic coils shall be supplied with factory installed drain and vent piping to the unit exterior.
2.07 FILTERS
   A. Provide factory-fabricated filter section of the same construction and finish as unit casings. Filter section shall have side access filter guides and access door(s) extending the full height of the casing to facilitate filter removal. Construct doors in accordance with Section 2.04. Provide fixed filter blockoffs as required to prevent air bypass around filters. Blockoffs shall not need to be removed during filter replacement. Filters to be of size, and quantity needed to maximize filter face area of each particular unit size.
   B. Filter type, MERV rating, and arrangement shall be provided as defined in project plans and schedule
   C. Manufacturer shall provide one set of startup filters.

2.08 DAMPERS
   A. All dampers, with the exception of external bypass and multizones (if scheduled), shall be internally mounted. Dampers shall be premium ultra low leak and located as indicated on the schedule and plans. Blade arrangement (parallel or opposed) shall be provided as indicated on the schedule and drawings. Dampers shall be Ruskin CD60 double-skin airfoil design or equivalent for minimal air leakage and pressure drop. Leakage rate shall not exceed 3 CFM/square foot at one inch water gauge complying with ASHRAE 90.1 maximum damper leakage and shall be AMCA licensed for Class 1A. All leakage testing and pressure ratings shall be based on AMCA Standard 500-D. Manufacturer shall submit brand and model of damper(s) being furnished, if not Ruskin CD60.

2.09 ACCESS SECTIONS
   A. Access sections shall be provided where indicated in the schedule and plans to allow additional access for inspection, cleaning, and maintenance of unit components. The unit shall be installed for proper access. Procedure for proper access, inspection and cleaning of the unit shall be provided in the AHU manufacturer’s maintenance manual. Access section doors shall be constructed per Section 2.04.

2.10 AIR MIXER/BLENDER SECTION
   A. Air mixers (blenders) shall be provided and located as indicated on the schedule and drawings. Mixers shall incorporate fixed blades, with no moving parts. Mixer panels shall be sized and installed in the unit with adequate distances upstream and downstream, based on the manufacturer’s cataloged performance, to ensure a minimum mixing effectiveness of 70% at 25% outside air, at one mixer diameter downstream of the mixer.

2.11 MARINE LIGHTS
   A. Marine lights shall be provided throughout AHUs as indicated on the schedule and plans. Lights shall be instant-on, light-emitting diode (LED) type to minimize amperage draw and shall produce lumens equivalent to a minimum 75W incandescent bulb (1200 lumens). LED lighting shall provide instant-on, white light and have a minimum 50,000 hr life.
   B. Light fixture shall be weather-resistant, gasketed to prevent water and dust intrusion.
   C. Fixtures shall be designed for flexible positioning during maintenance and service activities for best possible location providing full light on work surface of interest and not being blocked by
   D. All lights on a unit shall be wired in the factory to a single on-off switch.

2.12 INSTALLING CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING 115V SUPPLY TO THE FACTORY-MOUNTED MARINE LIGHT CIRCUIT (UNLESS SINGLE-POINT POWER IS SPECIFIED TO BE PROVIDED BY AHU MANUFACTURER).

PART 3 EXECUTION

3.01 SHIPPING
   A. Paper copies of the IOM shall also be shipped with each AHU.
   B. The AHU manufacturer shall identify all shipments with the order number. Enough information shall be provided with each shipment to enable the Mechanical Contractor to confirm the receipt
of units when they are received. For parts too small to mark individually, the AHU manufacturer shall place them in containers.

C. To protect equipment during shipment and delivery, all indoor units shall be completely stretch or shrink wrapped. Wrap shall be a minimum of 7 mil plastic. Pipe ends and pipe connection holes in the casing shall be capped or plugged prior to shipment.

D. After loading the equipment for shipment, the AHU manufacturer shall contact the shipping contact on the order and provide the name of the carrier, description of equipment, order number, shipping point, and date of shipment.

3.02 ON-SITE STORAGE

A. If equipment is to be stored for a period of time prior to installation, the Mechanical Contractor shall remove all stretch or shrink wrap from units upon receipt to prevent unit corrosion and shall either place the units in a controlled indoor environment or shall cover the units with canvas tarps and place them in a well-drained area. Covering units with plastic tarps shall not be acceptable.

3.03 FIELD EXAMINATION

A. The Mechanical Contractor shall verify that the mechanical room and/or roof are ready to receive work and the opening dimensions are as indicated on the shop drawings and contract documents.

B. The Mechanical Contractor shall verify that the proper power supply is available prior to starting of the fans.

3.04 INSTALLATION

A. The Mechanical Contractor shall be responsible to coordinate ALL of his installation requirements with the Owner and the Owner’s selected Mechanical Contractor to ensure that a complete installation for each unit is being provided. Coordination efforts shall include such items as unloading and hoisting requirements, field wiring requirements, field piping requirements, field ductwork requirements, requirements for assembly of field-bolted or welded joints, and all other installation and assembly requirements.

B. The AHU manufacturer shall provide all screws and gaskets for joining of sections in the field.

C. The Mechanical Contractor shall verify that the following items have been completed prior to scheduling the AHU manufacturer's final inspection and start up:

1. All spring-isolated components have had their shipping restraints removed and the components have been leveled.
2. On all field-joined units, that all interconnections have been completed, i.e., electrical and control wiring, piping, casing joints, bolting, welding, etc.
3. All water and steam piping connections have been completed and hydrostatically tested and all water flow rates have been set in accordance with the capacities scheduled on the Drawings.
4. All ductwork connections have been completed and all ductwork has been pressure tested for its intended service.
5. All power wiring, including motor starters and disconnects, serving the unit has been completed.
6. All automatic temperature and safety controls have been completed.
7. All dampers are fully operational.
8. All shipping materials have been removed.
9. All (clean) filter media has been installed in the units.

3.05 LEVELING

A. The Mechanical Contractor shall level all unit sections in accordance with the unit manufacturer’s instructions. The Mechanical Contractor shall provide and install all necessary permanent shim material to ensure individual sections and entire assembled units are level.
3.06 FINAL INSPECTION AND START UP SERVICE

A. After the Mechanical Contractor has provided all water and steam piping connections, ductwork connections, and field control wiring, and Electrical Contractor has provided all the field power wiring, the Mechanical Contractor shall inspect the installation. The Mechanical Contractor shall then perform startup of the equipment.

B. The Automatic Temperature Control (Building Direct Digital Control) Contractor shall be scheduled to be at the job site at the time of the equipment start up.

C. The Mechanical Contractor, shall perform the following tests and services and submit a report outlining the results:
   1. Record date, time, and person(s) performing service.
   2. Lubricate all moving parts.
   3. Check all motor and starter power lugs and tighten as required.
   4. Verify all electrical power connections.
   5. Conduct a start up inspection per the AHU manufacturer's recommendations.
   6. Record fan motor voltage and amperage readings.
   7. Check fan rotation and spin wheel to verify that rotation is free and does not rub or bind.
   8. Check fan for excessive vibration.
   9. Check V belt drive or coupling for proper alignment.
  10. Check V belt drive for proper tension. Tighten the belts in accordance with the AHU manufacturer's directions. Check belt tension during the second and seventh day's operation and re-adjust belts, as may be required, to maintain proper tension as directed by the AHU manufacturer.
  11. Remove all foreign loose material in ductwork leading to and from the fan and in the fan itself.
  12. Disengage all shipping fasteners on vibration isolation equipment.
  13. Check safety guards to insure they are properly secured.
  14. Secure all access doors to the fan, the unit and the ductwork.
  15. Switch electrical supply "on" and allow fan to reach full speed.
  16. Physically check each fan at start up and shut down to insure no abnormal or problem conditions exist.
  17. Check entering and leaving air temperatures (dry bulb and wet bulb) and simultaneously record entering and leaving chilled water temperatures and flow, steam pressures and flow, and outside air temperature.
  18. Check all control sequences.

3.07 CUSTOM AIR EQUIPMENT (AHU-5)

A. Basis of Design Manufacture
   1. Johnson MarCraft Inc – 11880 Dorsett Rd Maryland Heights MO 63043 (800) 325-1303
   2. Alternate Manufacturers (By pre approval by Engineer Only) Unit dimensions must be within 2" of listed dimensions on unit scheduled data. (shipping time is critical for this unit to complete prior to start of school.)
      a. Alternate manufacturers not listed must be approved in writing by the Consulting Engineer prior to the bid date.
   3. Unit Description:
      a. Location: Outdoor unit.
      b. Unit ETL label is required.
      c. Unit Sections: Reference the plan drawings for applicable sections.
   4. Custom Air Handling Unit Housing:
      a. General: Casing interior to be suitable for occasional wash/wipe down service. All interior seams shall be sealed with sealant. All seams in component safe-off baffles shall be sealed with sealant. Exterior casing shall incorporate a thermal break between the wall panels and exterior liner. Maximum wall-roof deflection to be 1/ 200
of span at operating conditions. Unit casing air leakage shall be limited to 1% of
design CFM at 1.25 times the design TSP.

b. Unit Base: Base frame constructed with structural channel around unit perimeter and
all section splits. Structural cross members shall be located on maximum 24" centers
and as required to support internal components and personnel service areas. All
exterior channel surfaces and welded junctions shall be coated with a corrosion
resistant paint. Each unit section shall be equipped with a minimum of 4
non-removable lifting lugs.

c. Unit Floor: Floor pan shall be 12 ga, G90 galvanized steel, non-sloping, with
continuous welded floor seams and a 2" turned up perimeter lip. Floor shall be
insulated with 4" sprayed-in polyurethane foam insulation protected with a 20 ga. G90
galvanized steel solid sheet metal vapor barrier. All floor penetrations shall be framed
with a collar extending 2" above the floor.

d. Emergency Use Floor Drains: Drains shall be 1.5" MPT schedule 40 galvanized steel,
piped through unit base to the exterior of the unit. Floor drains shall be provided as
indicated on the plan drawings. Traps are not provided.

e. Unit Wall Panels: 2" deep, 16 ga. Galvanized steel formed exterior panels, 20 ga.
Galvanized steel interior liner. All exterior seams shall be sealed with sealant. All
panels insulated with 1.55 lbs pcf density fiberglass insulation.

f. Unit Roof Panels (INDOOR): 2" deep, 20 ga. Galvanized formed interior panels, 16
ga. Bonderized steel exterior liner. Liner shall have ½" formed caulking bends and
shall be attached with corrosion resistant screws sealed with EPDM cup washers. All
exterior seams shall be sealed with sealant. All roof panels insulated with 1.55 lbs
pcf density fiberglass insulation.

g. Access Doors: 2" insulated double wall with aluminum extrusion frame, riveted
continuous stainless steel piano hinge; single gasket air seal; two plain finish, cam
lock handles equal to Ventlok model 260. Exterior panels to be 16 ga. Galvanized
steel, interior panels to be 20 ga. Galvanized steel. Positive pressure doors to open
inward and negative pressure doors to open out ward where ever possible.

h. Unit Access Panels: Access panels shall be of solid double wall construction similar to
the unit casing. Removable panels located as shown on the plan drawings.

i. Exterior Finish: The unit exterior surfaces shall be bright spangled galvanized.

j. Shipping sections: Units shall be shipped in section quantity and sizes as shown on
the plan drawings. Section openings shall be framed as required for structural
integrity.

5. Inlet plenum/ Mixing Box /Economizer Section:

a. Inlet sections shall be arranged as shown on the plan drawings. Casing openings
shall be provided with collars, if necessary, to facilitate field connection by others.

6. Panel Filter Section

a. Filters: 2" MERV 8 Pleated Filter Section.

b. Frames: Panel filter mounting frames shall be Type 8, Galvanized steel with gaskets.
Filters shall be retained with spring type fasteners. Filter banks shall be arranged for
upstream loading.

c. Filter Gauge: Filter banks shall be provided with a Dwyer series 2000 maneghelic
gauge. Gauge shall be provided with optional signal flag.

7. Fan Assembly

a. Fan: Fan shall be certified in accordance with AMCA standards 210 and 300. Fans
shall be arrangement 4 direct driven SWSI Plenum Fan with backward inclined airfoil
blades. Fan shall have a solid shaft of AISI Grade 1040/1045 hot rolled steel, turned
ground and polished and ring gauged for verification. Shafts are sized for a first
critical speed of at least 1.43 times the class maximum speed. The shaft and fan
wheel shall be dynamically balanced in two planes as a complete unit to a maximum
residual unbalance of 0.15 oz. at 95 percent of the fan wheel radius in each plane.
Fan assembly shall be coated with the manufacturer’s standard finish.

b. Fan Bearings: bearings shall be re-greaseable ball, or roller type, sized for a L50 life
of 200,000 hours, at fan operating conditions, per ANSI code B3.15.
c. Fan Options: Fans shall be supplied with the following options: neoprene coated flexible connection, inlet screen(s), plenum fan wheel guard, and open spring type thrust restraints. Motor: The motor shall be minimum UL Recognized, NEMA design B with class F insulation and a service factor of 115%. The motor shall be mounted on a slide type base. Motor shall be suitable for use with a VFD.
d. Isolation Base: The fan and motor assembly shall be mounted on a primed structural steel vibration isolation base. The base is supported on VMC/Amber Booth AMSR-2 spring type seismic isolators selected for 2" deflection and minimum 95% efficiency.

8. Cooling Coils
a. Cooling coils shall be chilled water type with performance based on 30% EG. All coils are of counter-flow construction with connections as shown on the plan drawings. Tube material shall be 5/8" OD, 0.020" thick, copper. Fin material shall be 0.0075" thick uncoated aluminum. Headers shall be seamless copper and provided with threaded vent and drain connections. Connections shall be red brass and terminate with MPT Threads. Coil casing material shall be 304 stainless steel. Coils shall be factory tested under water at 315 PSIG and guaranteed for 250 PSIG working pressures. Coils shall be rated and certified in accordance with ARI 410.
b. Coils shall be mounted to 304 stainless steel supports and baffle material.
c. The coil connections shall be individually extended to cabinet exterior.
d. Removable coil access panels are provided to facilitate coil removal. Slide racks fabricated from 304 stainless steel to allow individual coil removal are provided.
e. Drain pan: Main pan shall be minimum 3" deep, 16 ga 304 stainless steel sloped a minimum of three directions in the unit to minimize standing water with all seams and joints continuously welded. Pan shall be extended 3" upstream of coil and a minimum of 12" downstream of the coil. Main pain connection shall be 1.5" MPT schedule 40 stainless steel, piped through unit base to the exterior of the unit Necessary traps are provided by others and field installed by others.

9. Hot Water Heating Coils
a. Heating coils shall be hot water type with performance based on 100% water. All coils are of counter-flow construction with connections as shown on the plan drawings. Tube material shall be 5/8" OD, 0.020" thick, copper. Fin material shall be 0.0075" thick uncoated aluminum. Headers shall be seamless copper and provided with threaded vent and drain connections. Connections shall be red brass and terminate with MPT threads. Coil casing material shall be 304 stainless steel. Coils shall be factory tested under water at 315 PSIG and guaranteed for 250 PSIG working pressures. Coils shall be rated and certified in accordance with ARI 410.
b. Coils shall be mounted G90 galvanized steel supports and baffle material.
c. The coil connections shall be individually extended to cabinet exterior.
d. Removable coil access panels are provided to facilitate coil removal. Slide racks fabricated from G90 galvanized steel are provided to allow individual coil removal.

10. Electrical Interface:
a. General: Fan Motors wired to J-Box on exterior of unit.
b. Temperature Control: By OTHERS.
c. Variable Frequency Drives: By OTHERS.

B. MANUFACTURER QUALITY ASSURANCE PROCEDURES
1. The manufacturer shall provide the following quality assurance procedures.
a. Factory Testing: The following tests shall be performed prior to shipment and the report shall be furnished to the engineer.  
1) Electrical and Pneumatic Component Integrity Test: All electrical and pneumatic components shall be operated to assure that they are functioning properly. All electrical circuits shall be hi-pot tested to check insulation integrity.

C. EXECUTION
1. AHU Manufacturers Instructions
a. Comply with the AHU Manufactures and our component manufactures operations and installation manual, including product technical bulletins, product catalog installation instructions and product carton instructions for installation.
   1) Operation and Maintenance Manuals

b. Examination
   1) Site Verification of Conditions: Verify substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with the AHU manufactures instructions.
   2) Customer, at its own expense, shall inspect the equipment on delivery at the job site, and note any damage, needed repairs, missing parts, materials or components in writing on the Bill of Lading for return to the AHU Manufacture. Arrival, pre-startup and startup check lists will be included in the submittal

c. Installation
   1) The Customer is responsible for rigging and installation of the equipment and components at the Customer’s expense. Detailed Installation, Operation & Maintenance data is provided in the Marcraft IOM manual which is provided at time of unit shipment. Upon request, the IOM manual may be provided prior to unit shipment at any time after approval of this submittal is received. Installation includes but is not limited to the following:
   2) Pre site preparation: The structure that the unit shall be installed upon must be level and all weights and bearing loads must be verified. Upon request in writing, The AHU manufacturer shall supply a certified weight for the equipment prior to shipment.
   3) Rigging and lifting of equipment.
   4) Removal of shipping covers and internal braces/tiedowns.
   5) Attaching utilities including gas, fuel, water, steam, and electrical connections.
   6) Duct connections to the equipment.
   7) Wiring of electrical connections between shipping splits.
   8) Connecting of shipping splits including gaskets, bolts, screws, sheet metal, and welding as indicated by the AHU manufacturer, and component manufactures, operations and maintenance manuals.
   9) All other items required for proper installation, startup, and operation of the equipment pursuant to the AHU manufacturers instruction.

2. Protection
   a. Protect installed product and finish surfaces from damage during construction.
   1) Do not operate units(s) for any purpose, temporary or permanent, until ductwork is clean, filters in place, bearings lubricated, and fan has been tested under observation.

3.08 RELATED REQUIREMENTS
   A. Section 23 34 13 - Axial HVAC Fans.

3.09 REFERENCE STANDARDS
   A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015.
   C. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.
   G. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2014.
J. ASHRAE Std 62.1 - Ventilation for Acceptable Indoor Air Quality; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
K. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
M. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).

3.10 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

PART 2 PRODUCTS
4.01 CASING CONSTRUCTION
A. Full Perimeter Base Rail:
   2. Provide base rail of sufficient height to raise unit for external trapping of condensate drain pans.
B. Casing:
   1. Construct of one piece, insulated, double wall panels.
   2. Provide mid-span, no through metal, internal thermal break.
   3. Construct outer panels of galvanized steel and inner panels of galvanized steel.
   4. Casing Air Pressure Performance Requirements:
      a. Able to withstand up to 8 inches w.g. positive or negative static pressure.
      b. Not to exceed 0.0042 inches per inch deflection at 1.5 times design static pressure up to a maximum of plus 8 inches w.g. in positive pressure sections and minus 8 inches w.g. in negative pressure sections.
C. Access Doors:
   1. Construction, thermal and air pressure performance same as casing.
   2. Provide surface mounted handles on hinged, swing doors.
D. Unit Flooring: Construct with sufficient strength to support expected people and equipment loads associated with maintenance activities.
E. Casing Leakage: Seal joints and provide airtight access doors so that air leakage does not exceed one percent of design flow at the specified casing pressure.
F. Insulation:
   1. Provide minimum thermal thickness of 12 R throughout.
   2. Completely fill panel cavities in each direction to prevent voids and settling.
   3. Comply with NFPA 90A.
G. Drain Pan Construction:
   1. Provide cooling coil and humidifier sections with an insulated, double wall, galvanized steel drain pan complying with ASHRAE Std 62.1 for indoor air quality and sufficiently sized to collect all condensate.
   2. Slope in two planes to promote positive drainage and eliminate stagnate water conditions.
   3. Locate outlet of sufficient diameter at lowest point of pan to prevent overflow at normal operating conditions.
   4. Provide threaded drain connections constructed of drain pan material, extended sufficient distance beyond the base to accommodate field installed, condensate drain trapping.
H. Louvers: Stationary, of galvanized steel, 4 inch deep with plenum, nylon bearings, 1/2 inch mesh, 0.04 inch galvanized wire bird screen in aluminum frame, and bearing AMCA Certified Ratings Seal in accordance with AMCA 500-L. Furnish adjustable louvers with hollow vinyl bulb
edging on blades and foam side stops to limit leakage to maximum 2 percent at 4 inch wg differential pressure when sized for 2000 fpm face velocity.

I. Finish:

4.02 FAN SECTION

A. Type: Forward curved, single width, single inlet, centrifugal plug type fan, in compliance with AMCA 99. Refer to Section 23 34 13.

B. Performance Ratings: Determined in accordance with AMCA 210 and labeled with AMCA Certified Rating Seal.

C. Sound Ratings: AMCA 301; tested to AMCA 300 and label with AMCA Certified Sound Rating Seal.

D. Bearings: Self-aligning, grease lubricated, with lubrication fittings extended to exterior of casing with plastic tube and grease fitting rigidly attached to casing.

E. External Motor Junction Box: Factory mount NEMA 4 external junction box and connect to extended motor leads from internally mounted motors.

F. Motor Wiring Conduit: Factory wire fan motor wiring to the unit mounted starter-disconnect, variable frequency drive, external motor junction box, and ____________.

G. Fan Accessories:

H. Flexible Duct Connections:

I. Drives:


2. Bearings: Heavy duty pillow block type, ball bearings, with ABMA STD 9, L-10 life at 50,000 hours.

3. Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.

4. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, bored to fit shafts, and keyed. Variable and adjustable pitch sheaves for motors 15 hp and under selected so required rpm is obtained with sheaves set at mid-position; fixed sheave for 20 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.

5. Belt Guard: Fabricate to SMACNA (DCS); 0.106 inch thick, 3/4 inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

4.03 COIL SECTION

A. Casing: Provide access to both sides of coils. Enclose coils with headers and return bends exposed outside casing. Slide coils into casing through removable end panel with blank off sheets and sealing collars at connection penetrations.

B. Drain Pans: 24 inch downstream of coil and down spouts for cooling coil banks more than one coil high.

C. Eliminators: Three break of galvanized steel, mounted over drain pan.

D. Air Coils:

1. Certify capacities, pressure drops, and selection procedures in accordance with AHRI 410.

E. Fabrication:

1. Tubes: 5/8 inch OD seamless copper expanded into fins, brazed joints.

2. Fins: Aluminum.

3. Casing: Die formed channel frame of galvanized steel.
4.04 FILTER AND AIR CLEANER SECTION
   A. General: Provide filter sections with filter racks, minimum of one access door for filter removal, and filter block-offs to prevent air bypass.
   B. Differential Pressure Gauge:
      1. Provide factory installed dial type differential pressure gauge, flush mounted with casing outer wall, and fully piped to both sides of each filter to indicate status.
      2. Maintain plus/minus 5 percent accuracy within operating limits of 20 degrees F to 120 degrees F.

4.05 DAMPER SECTION
   A. Mixing Section: Provide a functional section to support the damper assembly for modulating the volume of outdoor, return, exhaust, and __________ air.
   B. Damper Blades:
      1. Double-skin airfoil design with metal, compressible jamb seals and extruded-vinyl blade-edge seals on each blade.
      2. Self-lubricating stainless steel or synthetic sleeve bearings.
      3. Comply with ASHRAE Std 90.1 I-P for rated maximum leakage rate.
      4. Provide leakage testing and pressure ratings in compliance with AMCA 500-D test methods.
      5. Arrange in parallel or opposed-blade configuration.
   C. Barometric Relief Dampers:
      1. Frame: Roll formed galvanized steel.
      2. Blades: Roll formed galvanized steel.
      4. Material:

END OF SECTION 23 73 13
SECTION 23 74 02
HIGH FRACTION OUTSIDE AIR PACKAGED ROOFTOP UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Energy recovery Rooftop Heat pump units. (RTHP 1-8)

1.02 SUMMARY
   A. This section includes rooftop heating and cooling units with dehumidification control.

1.03 CODES AND STANDARDS
   C. ASHRAE 90.1 - Energy Standard for Building Except Low-Rise Residential Buildings
   D. ASHRAE 15 - Safety Standard for Refrigeration Systems
   E. AHRI 1060 - Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation Equipment
   F. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus
   G. AMCA Standard 500-D - Laboratory Methods of Testing Dampers for Rating
   H. AMCA Standard 511 - Certified Rating Program - Product Rating Manual for Air Control Devices

1.04 SUBMITTALS
   A. Product Data: Include manufacturer’s technical data for each model indicated, including rated capacities of selected model clearly indicated; dimensions; required clearances; shipping, installed, and operating weights; furnished specialties; accessories; and installation and startup instructions.
   B. Shop drawings detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
   C. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
   D. Commissioning Reports: Indicate results of startup and testing commissioning requirements. Submit copies of checklists.
   F. Warranties: Special warranties specified in this section.

1.05 QUALITY ASSURANCE
   A. Fabricate and label refrigeration system to comply with ASHRAE 15.
   B. Energy Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1.
   C. Listing and Labeling: Provide electrically operated components specified in this section that are listed and labeled.
   D. The rooftop unit must be certified in accordance with UL Standard 1995 and ANSI Standard Z21.47 or the applicable Standards of another accredited testing laboratory that is engineer approved.
   E. The rooftop unit must be safety certified by an engineer approved accredited testing laboratory and the nameplate must carry the label of the certification agency. Two agencies that are engineer approved are UL and ETL.
1.06 DELIVERY, STORAGE, AND HANDLING
   A. Deliver rooftop units as factory-assembled units with protective crating and covering as recommended by the manufacturer.
   B. Coordinate delivery of units in sufficient time to allow movement onto building.
   C. Handle rooftop units to comply with manufacturer's written rigging and installation instructions for unloading and moving to final location.

1.07 COORDINATION
   A. Coordinate installation of roof curbs, equipment supports, and roof penetrations with roof construction.

1.08 WARRANTY
   A. General Warranty: The special warranty specified in this article must not deprive the owner of other rights the owner may have under other provisions of the Contract Documents and must be in addition to, and run concurrent with, other warranties made by the contractor under requirements of the Contract Documents.
   B. Special Warranty: A written warranty, executed by the manufacturer and signed by the Contractor, agreeing to replace components that fail in materials or workmanship, within the specified warranty period, provided manufacturer's written instructions for installation, operation, and maintenance have been followed.
   C. The manufacturer must provide startup services for the rooftop air handler.
   D. Warranty Period, Rooftop Unit: Manufacturer's standard, but not less than one year after date of startup, and not less than 14 months from date of shipment.
   E. Warranty Period, Compressors: Manufacturer's standard, but not less than five years from date of startup.
   F. Warranty Period, Heat Exchangers: Manufacturer's non-prorated full parts replacement not less than 10 years from date of startup.

1.09 EXTRA MATERIALS
   A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
   B. Filters: One set of filters shipped in the unit and one set of replacement filters shipped with the unit and inside their original containers. Alternatively, both sets of filters may ship in their original containers for field installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Manufacturers: Subject to strict compliance with the requirements of this specification, provide products by one of the following:
      1. Valent
      2. Trane
      3. Aaon
      4. Annexair

2.02 ROOFTOP UNITS
   A. Description:
      1. Factory assembled and tested; designed for roof or slab installation; and consisting of compressors, condensers, evaporator coils, hot gas reheat coils, condenser and evaporator fans, refrigeration and temperature controls, heater, filters, and dampers. The unit uses a high fraction of minimum outside air, ranging from 20% to 100%.
   B. Construction:
      1. Unit must be completely factory assembled, piped and wired and shipped in one section.
2. Unit must be specifically designed for outdoor roof top application with a fully weatherproof cabinet.
3. Exterior surfaces shall be constructed of pre-painted galvanized steel for aesthetics and long term durability. Paint finish to include a base primer with a high quality, polyester resin topcoat.
4. Panel construction shall be double-wall construction for all panels including floor panels. All floor panels shall have a solid galvanized steel inner liner on the air stream side of the unit to protect insulation during service and maintenance. Panel design shall include no exposed insulation edges.
5. Insulation shall be a two part injected foam, minimum 1" thick, R-value of 7.0 for units 3 - 15 tons. Insulation shall be a two part injected foam, minimum 2" thick, R-value of 13.0 for units 16 tons and greater.
6. Paint finish must be capable of withstanding at least 750 hours with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117 test procedure.
7. The unit roof must be sloped or cross-broken to assure drainage.
8. Unit specific color coded wiring diagrams must match the unit color coded wiring and will be provided in both point-to-point and ladder form.
9. Diagrams must also be laminated in plastic and permanently affixed inside the control compartment.
10. Access to filters, fans, heaters, and other items needing periodic checking or maintenance must be through hinged access doors with quarter turn latches. Door fastening screws are not acceptable.
11. Access doors must have stainless steel hinges, double wall construction and full perimeter gasketing.
12. All openings through the base pan of the unit must have upturned flanges of at least 1/2 inch in height around the opening through the base pan.
13. Air side service access doors must have rain break over hangs.
14. Unit must have decals and tags to indicate unit lifting and rigging, service areas and caution areas. Installation and maintenance manuals must be supplied with each unit.

C. Energy Recovery:
1. The rooftop unit shall be provided with an AHRI certified rotary wheel air-to-air heat exchanger in a cassette frame complete with seals, drive motor and drive belt. The energy recovery wheel shall be an integral part of the rooftop unit with unitary construction and does not require field assembly. Bolt-on energy recovery units that require field assembly and section to section gasketing and sealing are not acceptable.
3. The unit shall be designed with a track so the entire energy recovery wheel cassette can slide out from the unit to facilitate cleaning.
4. The unit shall have 2” Merv 8 filters for the outdoor air before the wheel to help keep the wheel clean and reduce maintenance. Filter access shall be by a hinged access door with ¼ turn latches.
5. The matrix design shall have channels to reduce cross contamination between the outdoor air and the exhaust air. The layers shall be effectively captured in aluminum and stainless steel segment frames that provide a rigid and self-supporting matrix. All diameter and perimeter seals shall be provided as part of the cassette assembly and shall be factory set. Drive belt(s) of stretch urethane shall be provided for wheel rim drive without the need for external tensioners or adjustment.
6. The total energy recovery wheel shall be coated with silica gel desiccant permanently bonded without the use of binders or adhesives, which may degrade desiccant performance. The substrate shall be lightweight polymer and shall not degrade nor require
additional coatings for application in marine or coastal environments. Coated segments shall be washable with detergent or alkaline coil cleaner and water. Desiccant shall not dissolve nor deliquesce in the presence of water or high humidity.

7. Wheels shall be provided with removable energy transfer matrix. Wheel frame construction shall be a welded hub, spoke and rim assembly of stainless, plated and/or coated steel and shall be self-supporting without matrix segments in place. Segments shall be removable without the use of tools to facilitate maintenance and cleaning.

8. Wheel bearings shall be selected to provide an L-10 life in excess of 400,000 hours. Rim shall be continuous rolled stainless steel. Wheels shall be connected to the shaft by means of taper lock hubs.

9. The control of the energy recovery wheel shall be an integral part of the unit’s DDC controls. The DDC controller shall have visibility of the outdoor air temperature, leaving wheel temperature, return air temperature, and exhaust air temperature. These temperatures shall be displayed at the unit’s DDC controller LCD display. All of these temperatures shall be made available through the BAS interface card.

10. The energy recovery wheel must be protected from frosting. The effectiveness of the energy recovery wheel must be modulated to prevent the leaving air temperature on the exhaust side from falling below 28º F (adj.) or the wheel surface from falling below 32º F. The energy recovery wheel may also be protected from frosting by using an electric preheat coil that heats the outside air from -10º F to 5º F. The electric preheat coil must be integral to the unit and powered by the unit’s ETL listed single point power connection.

11. The energy recovery wheel must have a variable effectiveness feature by modulating the speed of the energy recovery wheel. Wheel speed modulation must have at least a 20:1 turn down. The enthalpy wheel must run at full speed when the outside air enthalpy is higher than the return/exhaust air enthalpy. The wheel must be off when the outside air enthalpy is less than the return air enthalpy and the outside air dry bulb temperature is higher than the supply air dew point set point. The wheel must modulate to prevent supply air over heating when the outside air dry bulb temperature is lower than the supply air set point.

D. Filters:
   1. Unit shall be provided with a draw-through filter section designed to accept a 2” prefilter and 4” final filter.
   2. The filter section shall have a hinged access door.
   3. Filters shall be a minimum 2” thick, MERV 8.
   4. Return and exhaust filters shall be provided with energy recovery.

E. Water Source Heat Pump:
   a. Air/Refrigerant coil: Provide ARI rated coil with 0.016” thick seamless copper tubes, galvanized casing, and 0.006” thick aluminum fins, pressure tested and guaranteed for 250 psi working pressure. Provide stainless steel IAQ drain pan under the coil extending past the coil to ensure condensate retention. Maximum face velocity is 500 FPM.
   b. Hot Gas Reheat Coil: Provide ARI rated coil with 0.016” thick copper tubes, galvanized casing, and rippled aluminum plate fin secondary surface with a thickness of 0.006”. Provide coil with a two-way modulating control valve and modulating face/bypass damper for temperature control.
   c. Integral water source heat pump system: Provide integral water source heat pump system factory piped, wired, charged, and tested. Entire heat pump section must be assembled by the unit manufacturer. Mounting a different manufacturer’s heat pump in the casing is not acceptable.
      1) Integral water source heat pump consisting of: scroll compressors, air-refrigerant coil, water-refrigerant coil, 4-way reversing valve, suction accumulator, line filter-driers, sumpheaters. Water flow valves, valve actuators, and interlocks shall be provided but must be installed by others.
2) A minimum of 2 compressors must be used. An independent circuit will be provided for each compressor, tandem compressors are not acceptable in a heat pump application.

3) The compressors shall provide modulating control from 100% down to 10% of the full refrigeration system capacity. Staged control is not acceptable and will be rejected. Hot gas bypass is not an acceptable method of capacity control and will be rejected.

4) Provide coaxial water to refrigerant heat exchangers.

5) Independent circuits shall be provided completely tested, dehydrated, and fully charged with R-410A refrigerant and oil.

d. Water piping requirements:
   1) The heat pump manufacturer is responsible for the following water piping:
      (a) A strainer factory mounted at each water/refrigerant heat exchanger inlet.
      (b) P/T ports factory mounted on both sides of the water/refrigerant heat exchanger.
      (c) A flow switch factory mounted on the leaving water side of the water/refrigerant heat exchanger.
      (d) The manufacturer shall provide a modulating head pressure control valve for each heat pump circuit. The valve(s) will be shipped loose for field installation and wiring.
   2) The installing contractor is responsible for the following water piping:
      (a) All header & circuit piping required per drawings (refer to the schedule and/or submittal documents for quantity of compressors/circuits required on each unit).
      (b) Any field installed water piping must be insulated in the field by the installing contractor after final water balancing and test out.

1. The drain pan shall be stainless steel and positively sloped. The slope of the drain pan shall be in two directions and comply with ASHRAE Standard 62.1. The drain pan shall have a minimum slope of 1/8" per foot to provide positive draining. The drain pan shall extend beyond the leaving side of the coil. The drain pan shall have a threaded drain connection extending through the unit base.

F. Supply Fan:
   1. The supply fan shall be a single width, single inlet airfoil centrifugal fan. The fan wheel shall be Class II construction with aluminum fan blades that are continuously welded to the hub plate and end rim. The supply fan shall be a direct drive fan mounted to the motor shaft.
   2. All fan assemblies shall be statically and dynamically balanced at the factory, including a final trim balance, prior to shipment.
   3. 3 - 15 Ton Units
      a. The fan motor shall be a totally enclosed EC motor that is speed controlled by the unit DDC controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.

G. Exhaust Fan:
   1. The exhaust fan shall be a single width, single inlet airfoil centrifugal fan. The fan wheel shall be Class II construction with aluminum fan blades that are continuously welded to the hub plate and end rim. The exhaust fan shall be a direct drive fan mounted to the motor shaft.
   2. The fan motor shall be a totally enclosed EC motor that is speed controlled by the unit DDC controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.
3. The unit DDC controller shall provide building static pressure control. The unit controller shall provide proportional control of the exhaust fans from 25% to 100% of the supply air fan designed airflow to maintain the adjustable building pressure setpoint. The installing contractor shall mount the required sensing tubing from the building to the factory mounted building static pressure sensor.

4. The exhaust fan must be sized to exhaust 100% of unit’s rated supply airflow.

H. Condensing Section
1. Outdoor coils shall be cast aluminum, micro-channel coils. Plate fins shall be protected and brazed between adjoining flat tubes such that they shall not extend outside the tubes. A sub-cooling coil shall be an integral part of the main outdoor air coil. Each outdoor air coil shall be factory leak tested with high-pressure air under water.

2. Fan motors shall be an EC motor for proportional control. The unit controller shall proportionally control the speed of the condenser fan motors to maintain the head pressure of the refrigerant circuit from ambient condition of 0°F-120°F. Mechanical cooling shall be provided to 25°F. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase.

3. The condenser fan shall be low noise blade design. Fan blade design shall be a dynamic profile for low tip speed. Fan blade shall be of a composite material.

4. The unit shall have scroll compressors. One of the compressors shall be an inverter scroll compressor providing proportional control. The unit controller shall control the speed of the compressor to maintain the discharge air temperature. The inverter compressor shall have a separate oil pump and low oil safety protection.

5. Pressure transducers shall be provided for the suction pressure and head pressure. Temperature sensor shall be provided for the suction temperature and the refrigerant discharge temperature of the compressors. All of the above devices shall be an input to the unit controller and the values be displayed at the unit controller.

6. Each circuit shall be dehydrated and factory charged with R-410A Refrigerant and oil.

7. Each compressor must be equipped with suction and discharge service valves.

I. Power:
1. Unit must have a single point power connection.

2. Unit must be provided with a factory installed and wired internal non-fused disconnect.

3. Unit must be provided with phase and brown-out protection to shut down all motors in the unit if the phases are more than 10% out of balance on voltage or the voltage is more than 10% under design voltage or on phase reversal.

4. Unit must be provided with a factory installed and unit powered 115 volt, 15 amp ground fault interrupter protected service receptacle.

5. Controls:
6. Provide a complete integrated microprocessor based Direct Digital Control (DDC) system to control all unit functions including temperature control, scheduling, monitoring, unit safety protection, including compressor minimum run and minimum off times, and diagnostics.

7. This system shall consist of all required temperature sensors, pressure sensors, controller and keypad/display operator interface. All MCBs and sensors shall be factory mounted, wired and tested.

8. The control system must be capable of interfacing to a third party direct digital control system using at least one of these control protocols: BACNET MS/TP, or BACNET TCP/IP. The interface must pass at least all of the FMS points listed in the sequence of control. The hardware, software, licenses and startup services required to implement the interface must be provided as part of the base price of the rooftop unit.

J. Roof Curbs:
1. Roof curbs must be constructed of galvanized steel with corrosion protection coating, water-tight gaskets, and factory-installed wood nailer, complying with NRCA standards.

2. Insulation and adhesive must comply with NFPA 90A or 90B and be a minimum 1” thick.
3. Mechanical fasteners shall be galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner.
4. Liner material applied shall have air-stream surface coated with a temperature resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
5. Roof curbs are to be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support and air seal for the unit.
6. Gasketing must be furnished within the control compartment of the rooftop unit to be mounted on the curb immediately before mounting of the rooftop unit.
7. Roof curb shall be a minimum of 24” tall.

PART 3 EXECUTION

3.01 UNIT PREPARATION
A. Do not operate unit for any purpose, temporary or permanent, until ductwork is clean, filters and remote controls are in place, bearings lubricated and the manufacturer’s installation instructions have been completely followed.

3.02 FACTORY PREPARATION
A. The completed unit must have a factory run test prior to shipment. The factory run test must include a refrigeration circuit run test, refrigerant circuit leak test, unit control system test, and final inspection.

3.03 FACTORY STARTUP
A. Engage a factory-authorized service representative to perform startup service.
B. Complete installation and startup checks according to manufacturer’s written instructions.
C. Start unit according to manufacturer’s written instructions.

3.04 DEMONSTRATION
A. Engage a factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain the unit.

END OF SECTION 23 74 02
SECTION 23 74 16
PACKAGED, SMALL-CAPACITY, ROOFTOP AIR-CONDITIONING UNITS

PART 1 GENERAL  ROOF TOP UNITS (RTU-1, RTU-2)

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

1.02 SUMMARY
   A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:
      1. Direct-expansion cooling.
      2. Package rooftop unit.
      4. Refrigeration components.
      5. Unit operating controls.
      6. Roof curb.
      7. Electrical power connections.

1.03 DEFINITIONS
   A. DDC: Direct-digital controls.
   B. ECM: Electrically commutated motor.
   C. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.
   D. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.
   E. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.
   F. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.
   G. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

1.04 ACTION SUBMITTALS
   A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
   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.

1.05 INFORMATIONAL SUBMITTALS
   A. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
      1. Structural members to which RTUs will be attached.
      2. Roof openings
      3. Roof curbs and flashing.
   B. Warranty: Special warranty specified in this Section.
1.06 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

1.07 MAINTENANCE MATERIAL SUBMITTALS

1.08 EXTRA MATERIALS MAY NOT BE ALLOWED FOR PUBLICLY FUNDED PROJECTS.
   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. Fan Belts: One set for each belt-driven fan.
      2. Filters: One set of filters for each unit.

1.09 QUALITY ASSURANCE
   A. ARI Compliance:
      1. Comply with ARI 203/110 and ARI 303/110 for testing and rating energy efficiencies for RTUs.
      2. Comply with ARI 270 for testing and rating sound performance for RTUs.
   B. ASHRAE Compliance:
      1. Comply with ASHRAE 15 for refrigeration system safety.
      2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
      3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - “Systems and Equipment” and Section 7 - “Construction and Startup.”
   C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - “Heating, Ventilating, and Air-Conditioning.”
   D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.
   E. UL Compliance: Comply with UL 1995.
   F. 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.

1.10 WARRANTY
   A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.
      1. Warranty Period for Compressors: Manufacturer’s standard, but not less than five years from date of Substantial Completion.
      2. Warranty Period for Control Boards: Manufacturer’s standard, but not less than three years from date of Substantial Completion.
      3. Provide parts warranty for one year from start-up or 18 months from shipment, whichever is first.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Approved Manufacturers
      1. Trane
      2. York
      3. Daikin McQuay
      4. AAon
   B. Substitutions
      1. Substitutions: 10 working days prior approval required] as indicated under the general and/or supplemental conditions of these specifications. Mechanical contractor shall be responsible for electrical and mechanical changes to the structure when using a product other than the specified product. As built drawing changes are the responsibility of the mechanical contractor.
2.02 CASING

A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated Cabinet: Galvanized steel, phosphatized, and finished with an air-dry paint coating with removable access panels. Structural members shall be 16 gauge with access doors and removable panels of minimum 20 gauge.

B. Units cabinet surface shall be tested 1000 hours in salt spray test in compliance with ASTM B117.

C. Cabinet construction shall allow for all service/ maintenance from one side of the unit.

D. Cabinet top cover shall be one piece construction or where seams exits, it shall be double-hemmed and gasket-sealed.

E. Access Panels: Water- and air-tight panels with handles shall provide access to filters, heating section, return air fan section, supply air fan section, evaporator coil section, and unit control section.

F. Downflow unit's base pans shall have a raised 1 1/8 inch high lip around the supply and return openings for water integrity.

G. Insulation: Provide 1/2 inch thick coated fiberglass insulation on all exterior panels in contact with the return and conditioned air stream.

H. Provide openings either on side of unit or thru the base for power, control and gas connections.

I. The base of the unit shall have provisions for forklift and crane lifting

J. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

2.03 FANS

A. Provide evaporator fan section with forward curved, double width, double inlet, centrifugal type fan.

B. Provide variable frequency drives to control fan pressure for VAV operation.

C. Provide self-aligning, grease lubricated, ball or sleeve bearings with permanent lubrication fittings.

D. Provide units with belt driven, supply fans with adjustable motor sheaves.

E. Outdoor and Indoor Fan shall be permanently lubricated and have internal thermal overload protection.

F. Outdoor fans shall be direct drive, statically and dynamically balanced, draw through in the vertical discharge position.

G. Provide shafts constructed of solid hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.

H. Fan shaft shall be mounted on two grease lubricated ball bearings designed for 200,000 hours average life.

I. Provide extended grease lines shall allow greasing of bearings from unit filter section.

J. Fan motor and fan assembly shall be mounted on common base to allow consistent belt tension with no relative motion between fan and motor shafts. Entire assembly shall be completely isolated from unit and fan board by 2” deflection spring isolation.

2.04 COILS

A. Supply-Air Refrigerant Coil:
   1. Aluminum-plate fin and seamless internally grooved copper tube in steel casing with equalizing-type vertical distributor. Evaporator coil shall be inter-circuited to maintain active coil face area at part load conditions. Coil shall also utilize internally enhanced tubing for maximum efficiency.
   2. Provide a thermostatic expansion valve (TXV) for each refrigerant circuit. Factory pressure and leak test coil.

B. Outdoor-Air Refrigerant Coil:
   1. Aluminum-plate fin and seamless internally grooved copper tube in steel casing with equalizing-type vertical distributor.
   2. Provide subcooling circuit(s) integral with condenser coils to maximize efficiency and prevent premature flashing of liquid refrigerant, to a gaseous state, ahead of the expansion valve.
   3. Provide vertical discharge, direct drive fans with steel blades, and three phase motors. Fans shall be statically and dynamically balanced. Motors shall be permanently lubricated, with built-in current and thermal overload protection and weathertight slinger over motor bearings.
      a. Provide factory-installed louvered steel coil guards around perimeter of condensing section to protect the condenser coils, refrigerant piping and control.
   4. Aluminum-plate fin and seamless internally grooved copper tube in steel casing with equalizing-type vertical distributor. Evaporator coil shall be inter-circuited to maintain active coil face area at part load conditions. Coil shall also utilize internally enhanced tubing for maximum efficiency.

2.05 HOT GAS REHEAT COIL.
   A. Hot-Gas Reheat Refrigerant Coil:
      1. Aluminum-plate fin and seamless internally grooved copper tube in steel casing with equalizing-type vertical distributor.
      2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
      3. Baked phenolic coating.
   B. Condensate Drain Pan: Stainless steel formed with pitch and drain connections complying with ASHRAE 62.1.

2.06 GAS Furnace HEATING SECTION:
   A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47/CSA 2.3 and NFPA 54.
      1. CSA Approval: Designed and certified by and bearing label of CSA.
   B. Burners: Stainless steel.
      1. Fuel: Natural gas.
      2. Ignition: Electronically controlled electric spark or hot-surface igniter with flame sensor.
   C. Heat-Exchanger and Drain Pan: Stainless steel.
   D. Power Vent: Integral, motorized centrifugal fan interlocked with gas valve.

2.07 CONDENSER SECTION:
   A. Provide vertical discharge, direct drive fans with aluminum blades. Fans shall be statically balanced. Motors shall be permanently lubricated, with integral thermal overload protection in a weather tight casing.

2.08 REFRIGERANT CIRCUIT COMPONENTS
   A. Variable speed compressor shall be capable of speed modulation from 25 Hz to a maximum of 100 Hz. The minimum unit capacity shall be 15% of full load or less. The compressor motor shall be a permanent magnet type. Each compressor shall have a crankcase heater installed, properly sized to minimize the amount of liquid refrigerant present in the oil sump during off cycles. Compressors shall be equipped with a thrust bearing oil injection system that optimizes scroll set lubrication and controls the oil circulation rate. Optimal bearing lubrication shall be provided by a gear rotor oil pump. Each variable speed compressor shall be matched with a specially designed variable frequency drive which modulates the speed of the compressor
motor and provides several compressor protection functions. Control of the variable speed compressor and inverter control shall be integrated with the unit controller to ensure optimal equipment reliability and efficiency. The variable speed compressor shall be capable of speed modulation from 30 Hz to a maximum of 90 Hz. The minimum unit capacity shall be 15% Each compressor shall have a crank case heater installed, properly sized to minimize the amount of liquid refrigerant present in the oil sump during off cycles. Compressors shall be equipped with a thrust bearing oil injection system that optimizes scroll set lubrication and controls the oil circulation rate. Optimal bearing lubrication shall be provided by a gear rotor oil pump. Each variable speed compressor shall be matched with a specially designed variable frequency drive which modulates the speed of the compressor motor and provides several compressor protection functions. Control of the variable speed compressor and inverter control shall be integrated with the unit controller to ensure optimal equipment reliability and efficiency.

B. Provide with thermostatic motor winding temperature control to protect against excessive motor temperatures resulting from over-/under-voltage or loss of charge. Provide high and low pressure cutouts, and reset relay.

C. Provide factory-installed compressor lockout thermostat to prevent compressor operation at low ambient conditions.

D. Provide coil frost protection compressor unloading based on refrigerant circuit suction temperature to prevent coil frosting with minimum energy usage. As an alternate, factory-installed hot gas bypass shall be required on all VAV units to prevent coil frosting.

E. Refrigeration Specialties:
   1. Refrigerant: R-410A.
   2. Expansion valve with replaceable thermostatic element.
   3. Refrigerant filter/dryer.
   5. Automatic-reset low-pressure safety switch.
   8. Brass service valves installed in compressor suction and liquid lines.

2.09 VERIFY AVAILABLE FILTER TYPES WITH MANUFACTURER. INDICATE FILTER THICKNESS IN "CAPACITIES AND CHARACTERISTICS" ARTICLE OR IN A SCHEDULE.

A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
   1. Pleated: Minimum 90 percent arrestance, and MERV 7.

2.10 OUTDOOR AIR SECTION

A. Provide 100% modulating enthalpy-based economizer system fully integrated with unit return and exhaust air dampers. Unit operation is through primary temperature controls that automatically modulate dampers to maintain desired space temperature conditions.

B. Provide automatic outdoor enthalpy lockout sensor.

C. Provide adjustable minimum position control through the Bacnet interface.

D. Provide spring return motor for outside air damper closure during unit shutdown or power interruption.

2.11 EXHAUST /RETURN SECTION

A. 100 Percent Modulating Return Fan, A single width plenum fan with airfoil blade shall be mounted on a shaft with fixed sheave drive. The fan shall be dynamically balanced for the operating envelop and tested in factory before being installed in unit. The plenum fan shall be test run in unit as part of unit test. Fan operating envelope rpm shall be below first critical speed. Fan shaft shall be mounted on two grease lubricated ball or roller bearings designed for 200,000-hour average life. Extended grease lines shall be provided to allow greasing of bearings from section base rail. Fan motor and assembly shall be mounted on common base to allow consistent belt tension with no relative motion between fan and motor shafts. The entire
assembly shall be completely isolated from unit with 2-inch spring isolators. Discharge dampers at unit outlet shall modulate relief airflow in response to OA / return air damper position. The return fan VFD shall operate in conjunction with the supply fan.

B. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.

2.12 ELECTRICAL POWER CONNECTION

A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

2.13 CONTROLS

A. Control equipment and sequence of operation are specified on the drawings.

B. Interface Requirements for HVAC Instrumentation and Control System:
   1. Interface relay for scheduled operation.
   2. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
   3. Provide BACnet compatible interface for central HVAC control workstation for the following:
      a. Adjusting set points.
      b. Monitoring supply fan start, stop, and operation.
      c. Inquiring data to include outdoor-air damper position, supply- and room-air temperature and humidity.
      d. Monitoring occupied and unoccupied operations.
      e. Monitoring constant and variable motor loads.
      f. Monitoring variable-frequency drive operation.
      g. Monitoring cooling load.
      h. Monitoring economizer cycles.
      i. Monitoring air-distribution static pressure and ventilation air volume.
      j. Refer to drawings for sequences of operation and minimum control points.

2.14 ACCESSORIES COMPARTMENT

A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.

B. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.

2.15 ROOF CURBS

A. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
   1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
      a. Materials: ASTM C 1071, Type I or II.
      b. Thickness: 1-1/2 inches.
      c. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
         1) Liner Adhesive: Comply with ASTM C 916, Type I.
         2) Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
         3) Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
         4) Liner Adhesive: Comply with ASTM C 916, Type I.
B. Curb Height: 48 inches. Note: Curb is a side discharge with large supply and return out the side of the curb through the Gymnasium exterior wall. Smaller supply and return will also exit the curb on the bottom of the curb into the building below.

2.16 CAPACITIES AND CHARACTERISTICS
A. Refer to drawings for performance and data for units.

PART 3 EXECUTION

3.01 EXAMINATION
A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.
B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.
C. Examine roofs for suitable conditions where RTUs will be installed.
D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION
A. Equipment Mounting:
   1. Comply with requirements for vibration isolation devices specified in Section 23 05 48.13 "Vibration Controls for HVAC."
B. Roof Curb: Install on roof structure level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." ARI Guideline B. Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 07 72 00 "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.

3.03 CONNECTIONS
A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.
B. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
   1. Install ducts to termination at top and sides of roof curb.
   2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
   3. Connect supply ducts to RTUs with flexible duct connectors specified in Section 23 33 00 "Air Duct Accessories."
   4. Install return-air duct continuously through roof structure.

3.04 SEE EVALUATIONS FOR DISCUSSION OF CONCRETE INSIDE CURBS.

3.05 FIELD QUALITY CONTROL
A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

3.06 RETAIN PARAGRAPH BELOW TO REQUIRE CONTRACTOR TO PERFORM TESTS AND INSPECTIONS.
A. Perform tests and inspections and prepare test reports.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.
B. Tests and Inspections:
   1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.07 STARTUP SERVICE
A. Engage a factory-authorized service representative to perform startup service.
B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
   1. Inspect for visible damage to unit casing.
   2. Inspect for visible damage to compressor, coils, and fans.
   3. Inspect internal insulation.
   4. Verify that labels are clearly visible.
   5. Verify that clearances have been provided for servicing.
   6. Verify that controls are connected and operable.
   7. Verify that filters are installed.
   8. Clean condenser coil and inspect for construction debris.

3.08 RETAIN FIRST TWO SUBPARAGRAPHS BELOW FOR GAS-FIRED RTUS.
A. Clean furnace flue and inspect for construction debris.
B. Remove packing from vibration isolators.

3.09 RETAIN FIRST SUBPARAGRAPH BELOW FOR BAROMETRIC RELIEF DAMPERS.
A. Inspect operation of barometric relief dampers.
B. Verify lubrication on fan and motor bearings.
C. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
D. Adjust fan belts to proper alignment and tension.
E. Start unit according to manufacturer's written instructions.
   1. Start refrigeration system.
   2. Do not operate below recommended low-ambient temperature.
   3. Complete startup sheets and attach copy with Contractor's startup report.
      a. Inspect and record performance of interlocks and protective devices; verify sequences.
      b. Operate unit for an initial period as recommended or required by manufacturer.
      c. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency.
      d. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
      e. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:
         1) Coil leaving-air, dry- and wet-bulb temperatures.
         2) Coil entering-air, dry- and wet-bulb temperatures.
         3) Outdoor-air, dry-bulb temperature.
         4) Outdoor-air-coil, discharge-air, dry-bulb temperature.
      f. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
      g. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
         1) Supply-air volume.
         2) Return-air volume.
         3) Relief-air volume.
         4) Outdoor-air intake volume.
h. Simulate maximum cooling demand and inspect the following:
   1) Compressor refrigerant suction and hot-gas pressures.
   2) Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.

i. Verify operation of remote panel including pilot-light operation and failure modes.
   Inspect the following:
   1) Low-temperature safety operation.
   2) Filter high-pressure differential alarm.
   3) Economizer to minimum outdoor-air changeover.
   4) Relief-air fan operation.
   5) Smoke and firestat alarms.

j. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.10 CLEANING AND ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.

B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs. Refer to Section 01 79 00 "Demonstration and Training."

END OF SECTION 23 74 16
SECTION 23 82 39.13
CABINET UNIT HEATERS

PART 1 GENERAL
1.01 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary
      Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
   A. Section includes cabinet unit heaters with centrifugal fans and electric-resistance heating coils.

1.03 DEFINITIONS
   A. BAS: Building automation system.
   B. CWP: Cold working pressure.
   C. PTFE: Polytetrafluoroethylene plastic.
   D. TFE: Tetrafluoroethylene plastic.

1.04 ACTION SUBMITTALS
   A. Product Data: For each type of product.
      1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
   B. Samples: For each exposed product and for each color and texture specified.
   C. Samples for Initial Selection: Finish colors for units with factory-applied color finishes.
   D. Samples for Verification: Finish colors for each type of cabinet unit heater indicated with
      factory-applied color finishes.

1.05 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation,
      and maintenance manuals.

1.06 MAINTENANCE MATERIAL SUBMITTALS
   A. Furnish extra materials described below that match products installed and that are packaged
      with protective covering for storage and identified with labels describing contents.
      1. Cabinet Unit-Heater Filters: Furnish one spare filter(s) for each filter installed.

PART 2 PRODUCTS
2.01 MANUFACTURERS
   A. Manufacturers: Subject to compliance with requirements, provide products by the following:
      1. Airtherm; a Mestek company.
      2. Berko; Marley Engineered Products.
      3. Carrier Corporation; a UTC company.
      4. Chromalox, Inc.
      5. Dunham-Bush, Inc.
      6. Engineered Air.
      7. Indeeco.
     10. Marley Engineered Products.
     11. McQuay International.
     12. Ouellet Canada Inc.
     13. QMark; Marley Engineered Products.
     14. Rosemex Products.
     15. Trane Inc.
     16. USA Coil & Air.
2.02 DESCRIPTION
A. Factory-assembled and -tested unit complying with AHRI 440.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
C. Comply with UL 2021.

2.03 PERFORMANCE REQUIREMENTS
A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

2.04 COIL SECTION INSULATION
A. Insulation Materials: ASTM C 1071; surfaces exposed to airstream shall have aluminum-foil facing to prevent erosion of glass fibers.
   1. Thickness: 1/2 inch.
   2. Thermal Conductivity (k-Value): 0.26 Btu x in./h x sq. ft. at 75 deg F mean temperature.
   3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
   4. Adhesive: Comply with ASTM C 916 and with NFPA 90A or NFPA 90B.
   5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
B. Insulation Materials: Comply with NFPA 90A or NFPA 90B. Unicellular polyethylene thermal plastic, preformed sheet insulation complying with ASTM C 534, Type II, except for density.
   1. Thickness: 3/8 inch.
   2. Thermal Conductivity (k-Value): 0.24 Btu x in./h x sq. ft. at 75 deg F mean temperature.
   3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM C 411.
   4. Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
   5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

2.05 CABINETS
A. Material: Steel with baked-enamel finish with manufacturer's standard paint, in color selected by Architect.
   1. Vertical Unit, Exposed Front Panels: Minimum 0.0528-inch-thick sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.
   2. Horizontal Unit, Exposed Bottom Panels: Minimum 0.0528-inch-thick sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.
   3. Recessed Flanges: Steel, finished to match cabinet.
   4. Control Access Door: Key operated.
   5. Base: Minimum 0.0528-inch-thick steel, finished to match cabinet, high with leveling bolts.
   6. False Back: Minimum 0.0428-inch-thick steel, finished to match cabinet.

2.06 FILTERS
A. Minimum Arrestance: According to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
   1. Glass Fiber Treated with Adhesive: 80 percent arrestance and MERV 5.

2.07 COILS
A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, mounted in ceramic inserts in galvanized-steel housing; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.
2.08 CONTROLS
A. Fan and Motor Board: Removable.
   1. Fan: Forward curved, double width, centrifugal, directly connected to motor; thermoplastic or painted-steel wheels and aluminum, painted-steel, or galvanized-steel fan scrolls.
   3. Wiring Terminations: Connect motor to chassis wiring with plug connection.
B. Control devices and operational sequences are specified in Section 23 09 00 "Instrumentation and Control for HVAC" and Section 23 09 93 "Sequence of Operations for HVAC Controls."
C. Basic Unit Controls:
   1. Control voltage transformer.
D. DDC Terminal Controller:
E. Electrical Connection: Factory-wired motors and controls for a single field connection.

2.09 CAPACITIES AND CHARACTERISTICS
A. As scheduled on the drawings.

PART 3 EXECUTION

3.01 EXAMINATION
A. Examine areas to receive cabinet unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
B. Examine roughing-in for electrical connections to verify actual locations before unit-heater installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION
A. Install wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Section 07 92 00 "Joint Sealants."
B. Install cabinet unit heaters to comply with NFPA 90A.
C. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
D. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.03 CONNECTIONS
A. Comply with safety requirements in UL 1995.
B. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
C. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.04 FIELD QUALITY CONTROL
A. Perform the following tests and inspections:
   1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
   3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
B. Units will be considered defective if they do not pass tests and inspections.
3.05 ADJUSTING

A. Adjust initial temperature set points.

END OF SECTION 23 82 39.13
SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Building wires and cables rated 600 V and less.
   2. Connectors, splices, and terminations rated 600 V and less.

1.02 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 PRODUCTS

2.01 CONDUCTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Alcan Products Corporation; Alcan Cable Division.
   2. Alpha Wire.
   3. Belden Inc.
   5. General Cable Technologies Corporation.

B. Aluminum and Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2.

2.02 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AFC Cable Systems, Inc.
   2. Gardner Bender.
   4. Ideal Industries, Inc.
   5. Ilsco; a branch of Bardes Corporation.
   6. NSi Industries LLC.
   7. O-Z/Gedney; a brand of the EGS Electrical Group.
   8. 3M; Electrical Markets Division.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.03 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

PART 3 EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger, except VFC cable, which shall be extra flexible stranded.

3.02 CONDUCTOR INSULATION AND WIRING METHODS

A. Service Entrance: Type THHN-2-THWN-2, single conductors in raceway.
B. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway.
C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-2-THWN-2, single conductors in raceway.
D. Exposed Branch Circuits, Including in Crawlspace: Type THHN-2-THWN-2, single conductors in raceway.

3.03 INSTALLATION OF CONDUCTORS
A. Conceal conduit in finished walls, ceilings, and floors unless otherwise indicated.
B. Complete raceway installation between conductor and cable termination points according to Section 26 05 33 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
F. Support cables according to Section 26 05 29 "Hangers and Supports for Electrical Systems."

3.04 CONNECTIONS
A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
   1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

3.05 IDENTIFICATION
A. Identify and color-code conductors and cables according to Section 26 05 53 "Identification for Electrical Systems."
B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.06 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS
A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.07 FIRESTOPPING
A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to applicable codes.

3.08 FIELD QUALITY CONTROL
A. Perform the following tests and inspections:
   1. After installing conductors and before electrical circuitry has been energized, test feeder conductors for compliance with requirements.
B. Test and Inspection Reports: Prepare a written report to record the following:
   1. Procedures used.
   2. Results that comply with requirements.
3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 26 05 19
SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL
1.01 SUMMARY
A. Section Includes: Grounding systems and equipment.

1.02 INFORMATIONAL SUBMITTALS
A. Field quality-control reports.

1.03 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 PRODUCTS
2.01 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:
   4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
   5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
   6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
   7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.02 CONNECTORS
A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, 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.
D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

PART 3 EXECUTION
3.01 APPLICATIONS
A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger unless otherwise indicated.

3.02 EQUIPMENT GROUNDING
A. Install insulated equipment grounding conductors with all feeders and branch circuits.
3.03 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. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
   3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

3.04 LABELING

A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems" for instruction signs. The label or its text shall be green.

B. Install labels at the telecommunications bonding conductor and grounding equalizer.
   1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.05 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
   2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer’s written instructions.

END OF SECTION 26 05 26
SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1  GENERAL

1.01  SUMMARY

A. This Section includes the following:
   1. Hangers and supports for electrical equipment and systems.
   2. Construction requirements for concrete bases.

1.02  DEFINITIONS

A. EMT: Electrical metallic tubing.
B. IMC: Intermediate metal conduit.
C. RMC: Rigid metal conduit.

1.03  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.

1.04  COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.
B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2  PRODUCTS

2.01  SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allied Tube & Conduit.
      b. Cooper B-Line, Inc.; a division of Cooper Industries.
      c. ERICO International Corporation.
      d. GS Metals Corp.
      e. Thomas & Betts Corporation.
      f. Unistrut; Tyco International, Ltd.
      g. Wesanco, Inc.
   2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
   4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
   5. 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.
   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Hilti Inc.
      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.
      4) Simpson Strong-Tie Co., Inc.; Masteset Fastening Systems Unit.

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.
   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Cooper B-Line, Inc.; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti Inc.
      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      5) MKT Fastening, LLC.

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.


2.02 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 EXECUTION

3.01 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 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 conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.
3.02 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
   1. To Wood: Fasten with lag screws or through bolts.
   2. To New Concrete: Bolt to concrete inserts.
   3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   4. To Existing Concrete: Expansion anchor fasteners.
   5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
   6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
   7. To Light Steel: Sheet metal screws.
   8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

3.04 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 03 30 00 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.
   1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor bolts to elevations required for proper attachment to supported equipment.
   3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.05 PAINTING

A. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29
SECTION 26 05 33
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL
1.01 SUMMARY
   A. Section Includes:
      1. Metal conduits, tubing, and fittings.
      2. Metal wireways and auxiliary gutters.
      3. Surface raceways.

1.02 DEFINITIONS
   A. EMT: Electrical metallic tubing.
   B. FMC: Flexible metallic conduit.
   C. GRC: Galvanized rigid steel conduit.
   D. IMC: Intermediate metal conduit.
   E. LFMC: Liquid tight flexible metallic conduit.

PART 2 PRODUCTS
2.01 METAL CONDUITS, TUBING, AND FITTINGS
   A. Manufacturers: Subject to compliance with requirements, provide products by the following:
      1. AFC Cable Systems, Inc.
      3. Anamet Electrical, Inc.
      4. Electri-Flex Company.
      5. O-Z/Gedney; a brand of EGS Electrical Group.
      6. Picoma Industries, a subsidiary of Mueller Water Products, Inc.
      7. Republic Conduit.
      8. Robroy Industries.
     10. Thomas & Betts Corporation.
     11. Western Tube and Conduit Corporation.
     12. Wheatland Tube Company; a division of John Maneely Company.
   B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in
      NFPA 70, by a qualified testing agency, and marked for intended location and application.
   C. GRC: Comply with ANSI C80.1 and UL 6.
   D. IMC: Comply with ANSI C80.6 and UL 1242.
   E. EMT: Comply with ANSI C80.3 and UL 797.
   F. FMC: Comply with UL 1; zinc-coated steel.
   G. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
   H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
      1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
      2. Fittings for EMT:
         a. Material: Steel or die cast.
         b. Type: Setscrew or compression.
      3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for
         environmental conditions where installed, and including flexible external bonding jumper.
   I. Joint Compound for IMC or GRC: Approved, as defined in NFPA 70, by authorities having
      jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect
      threaded conduit joints from corrosion and to enhance their conductivity.
2.02 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Cooper B-Line, Inc.
   2. Hoffman; a Pentair company.
   4. Square D; a brand of Schneider Electric.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
   1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw-cover type Flanged-and-gasketed type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.03 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Adalet.
   2. Cooper Technologies Company; Cooper Crouse-Hinds.
   3. EGS/Appleton Electric.
   5. FSR Inc.
   6. Hoffman; a Pentair company.
   7. Hubbell Incorporated; Killark Division.
   8. Kraloy.
  10. Mono-Systems, Inc.
  12. RACO; a Hubbell Company.
  13. Robroy Industries.
  14. Spring City Electrical Manufacturing Company.
  15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
  17. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Luminaires Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

I. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

J. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
   2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

L. Cabinets:
   1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
   2. Hinged door in front cover with flush latch and concealed hinge.
   3. Key latch to match panelboards.
   4. Metal barriers to separate wiring of different systems and voltage.
   5. Accessory feet where required for freestanding equipment.
   6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 EXECUTION

3.01 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
   1. Exposed Conduit: GRC or IMC.
   2. Concealed Conduit, Aboveground: GRC or IMC.
   3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
   4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:
   1. Exposed, Not Subject to Physical Damage: EMT.
   2. Concealed in Ceilings and Interior Walls and Partitions: EMT.
   3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
   4. Damp or Wet Locations: GRC or IMC.
   5. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 1/2-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.
   1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
   2. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
   3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.02 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches of enclosures to which attached.

I. Stub-ups to Above Recessed Ceilings:
   1. Use EMT, IMC, or RMC for raceways.
   2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

K. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

L. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

M. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

N. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

O. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

P. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

Q. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

R. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
   1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
   2. Where an underground service raceway enters a building or structure.
   3. Where otherwise required by NFPA 70.

S. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

T. Expansion-Joint Fittings:
   1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
   2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
      a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
      b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
      c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
d. Attics: 135 deg F temperature change.

3. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

4. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer’s written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

U. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.

2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

V. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

W. Locate boxes so that cover or plate will not span different building finishes.

X. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

Y. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.03 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.04 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies

3.05 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

END OF SECTION 26 05 33
SECTION 26 05 44
SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABELING

PART 1 GENERAL

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

1.02 SUMMARY
A. Section Includes:
1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
5. Silicone sealants.
B. Related Requirements:
1. Firestopping section for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

PART 2 PRODUCTS

2.01 SLEEVES
A. Wall Sleeves:
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
F. Sleeves for Rectangular Openings:
2. Minimum Metal Thickness:
   a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
   b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.02 SLEEVE-SEAL SYSTEMS
A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.03 SLEEVE-SEAL FITTINGS
A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
2.04 GROUT
A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
C. Design Mix: 5000-psi, 28-day compressive strength.
D. Packaging: Premixed and factory packaged.

2.05 SILICONE SEALANTS
A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
   1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 EXECUTION
3.01 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS
A. Comply with NECA 1.
B. Comply with NEMA VE 2 for cable tray and cable penetrations.
C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
   1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
      a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 07 92 00 "Joint Sealants."
      b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
   2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
   3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
   4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
   1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
   2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.02 SLEEVE-SEAL-SYSTEM INSTALLATION
A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.03 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
C. Secure nailing flanges to concrete forms.
D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 26 05 44
SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY
A. Section Includes:
   1. Identification for raceways.
   2. Identification of power and control cables.
   3. Identification for conductors.
   5. Warning labels and signs.
   6. Instruction signs.
   7. Equipment identification labels.
   8. Miscellaneous identification products.

1.02 QUALITY ASSURANCE
A. Comply with ANSI A13.1.
B. Comply with NFPA 70.
D. Comply with ANSI Z535.4 for safety signs and labels.
E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.03 COORDINATION
A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
C. Coordinate installation of identifying devices with location of access panels and doors.
D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.01 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS
A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
B. Colors for Raceways Carrying Circuits at 600 V or Less:
   1. Black letters on an orange field.
   2. Legend: Indicate voltage.
C. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
D. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
E. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
F. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
2.02 ARMORED 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 cable size.

B. Colors for Cables Carrying Circuits at 600 V and Less:
   1. Black letters on an orange field
   2. Legend: Indicate voltage.

C. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

E. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.

2.03 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

C. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil-thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.

D. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.

E. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

F. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

G. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

2.04 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted Write-on, 3-mil-thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.

C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.

D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.

E. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around conductor it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.

F. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
2.05 FLOOR MARKING TAPE
A. 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

2.06 UNDERGROUND-LINE WARNING TAPE
A. Tape:
   1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
   2. Printing on tape shall be permanent and shall not be damaged by burial operations.
   3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:
   1. Comply with ANSI Z535.1 through ANSI Z535.5.
   2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE,
   3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.
   4. Pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
   5. Thickness: 4 mils.
   6. Weight: 18.5 lb/1000 sq. ft.
   7. 3-Inch Tensile According to ASTM D 882: 30 lbf, and 2500 psi.

2.07 WARNING LABELS AND SIGNS

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:
   1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
   2. 1/4-inch grommets in corners for mounting.
   3. Nominal size, 7 by 10 inches.

D. Metal-Backed, Butyrate Warning Signs:
   1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
   2. 1/4-inch grommets in corners for mounting.
   3. Nominal size, 10 by 14 inches.

E. Warning label and sign shall include, but are not limited to, the following legends:
   1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
   2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.08 INSTRUCTION SIGNS
A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
   1. Engraved legend with black letters on white face.
   2. Punched or drilled for mechanical fasteners.
   3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process.
   Minimum letter height shall be 3/8 inch.
C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.09 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.


E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.10 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
   2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
   3. Temperature Range: Minus 40 to plus 185 deg F.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
   2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
   3. Temperature Range: Minus 40 to plus 185 deg F.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
   2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
   3. UL 94 Flame Rating: 94V-0.
   4. Temperature Range: Minus 50 to plus 284 deg F.
   5. Color: Black.

2.11 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 EXECUTION

3.01 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
IDENTIFICATION FOR ELECTRICAL SYSTEMS

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.

G. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

I. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
   1. Outdoors: UV-stabilized nylon.
   2. In Spaces Handling Environmental Air: Plenum rated.

J. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

K. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.02 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
   1. Power.

B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
   1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
      a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
      b. Colors for 208/120-V Circuits:
         1) Phase A: Black.
         2) Phase B: Red.
         3) Phase C: Blue.
      c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

C. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

D. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use write-on tags self-adhesive, self-laminating polyester labels or self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.

E. Control-Circuit Conductor Termination Identification: For identification at terminations provide heat-shrink preprinted tubes self-adhesive, self-laminating polyester labels or self-adhesive vinyl labels with the conductor designation.

F. Conduits to Be Extended in the Future: Attach write-on tags to conductors and list source.

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.

H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
   1. Limit use of underground-line warning tape to direct-buried cables.
   2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

I. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
   2. Identify system voltage with black letters on an orange background.
   3. Apply to exterior of door, cover, or other access.
   4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
      a. Power transfer switches.
      b. Controls with external control power connections.

K. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

L. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
   1. Labeling Instructions:
      a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
      b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
      c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
      d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
   2. Equipment to Be Labeled:
      a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
      b. Enclosures and electrical cabinets.
      c. Access doors and panels for concealed electrical items.
      d. Switchboards.
      e. Enclosed switches.
      f. Enclosed circuit breakers.
      g. Enclosed controllers.

END OF SECTION 26 05 53
SECTION 26 09 23
LIGHTING CONTROL DEVICES

PART 1  GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Indoor occupancy sensors.
   2. Digital Room Controller.
   3. Room Controller Wall Stations.

1.03 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Shop Drawings: Show installation details for occupancy and light-level sensors.
   1. Interconnection diagrams showing field-installed wiring.
   2. Include diagrams for power, signal, and control wiring.

1.04 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2  PRODUCTS

2.01 INDOOR OCCUPANCY SENSORS
A. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
   3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
   4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
   5. Mounting:
      a. Sensor: Suitable for mounting in any position on a standard outlet box.
      b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
      c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
   6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
   7. Bypass Switch: Override the "on" function in case of sensor failure.
   8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
B. PIR Type: Ceiling mounted; detect occupants in coverage area by their heat and movement.
   1. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in..
   2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot-high ceiling.

C. Ultrasonic Type: Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.
   1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
   2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch-high ceiling.
   3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
   4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch-high ceiling.
   5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot-high ceiling in a corridor not wider than 14 feet.

D. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
   1. Sensitivity Adjustment: Separate for each sensing technology.
   2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
   3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.

2.02 SWITCHBOX-MOUNTED OCCUPANCY SENSORS
A. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
   3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.

2.03 DIGITAL ROOM CONTROLLER
A. Manufacturer: Subject to compliance with requirements, provide Wattstopper, Cooper / Greengate, Hubbell, or comparable product.
B. Plenum-rated controllers with line voltage relay(s) and 0-10 volt dimming outputs.
C. Capable of integrating multiple control components including daylight sensors, occupancy sensors, and manual switches for energy-efficient lighting control options.

2.04 ROOM CONTROLLER WALL STATIONS
A. Low voltage control for On/Off and Dimming loads.
B. 24 VDC power supplied by the Room Controller.
C. Field replaceable, pre-engraved optional button configurations.
D. RJ45 QuickConnect ports.

2.05 CONDUCTORS AND CABLES
A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 EXECUTION

3.01 SENSOR INSTALLATION
A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.02 WIRING INSTALLATION
A. Wiring Method: Comply with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.03 IDENTIFICATION
A. Identify components and power and control wiring according to Section 26 05 53 "Identification for Electrical Systems."
   1. Identify controlled circuits in lighting contactors.
   2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
B. Label time switches and contactors with a unique designation.

3.04 FIELD QUALITY CONTROL
A. Perform the following tests and inspections:
   1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
B. Lighting control devices will be considered defective if they do not pass tests and inspections.
C. Prepare test and inspection reports.

3.05 ADJUSTING
A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
   1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

END OF SECTION 26 09 23
SECTION 26 24 16
PANELBOARDS

PART 1 GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Lighting and appliance branch-circuit panelboards.

1.03 ACTION SUBMITTALS
A. Product Data: For each type of panelboard, switching and overcurrent protective device,
   transient voltage suppression device, 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 other than NEMA 250, Type 1.
   3. Detail bus configuration, current, and voltage ratings.
   4. Short-circuit current rating of panelboards and overcurrent protective devices.
   5. Include evidence of NRTL listing for series rating of installed devices.
   6. Detail features, characteristics, ratings, and factory settings of individual overcurrent
      protective devices and auxiliary components.
   7. Include wiring diagrams for power, signal, and control wiring.
   8. Include time-current coordination curves for each type and rating of overcurrent protective
      device included in panelboards. Submit on translucent log-log graft paper; include
      selectable ranges for each type of overcurrent protective device.

1.04 QUALITY ASSURANCE
A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and
   accessories from single source from single manufacturer.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70,
   by a qualified testing agency, and marked for intended location and application.
C. Comply with NEMA PB 1.
D. Comply with NFPA 70.

1.05 COORDINATION
A. Coordinate layout and installation of panelboards and components with other construction that
   penetrates walls or is supported by them, including electrical and other types of equipment,
   raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces.
   Maintain required workspace clearances and required clearances for equipment access doors
   and panels.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS FOR PANELBOARDS
A. Enclosures: Flush-mounted cabinets.
   1. Rated for environmental conditions at installed location.
      a. Indoor Dry and Clean Locations: NEMA 250, 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 pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.

B. Phase, Neutral, and Ground Buses:
1. Material: Copper.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

C. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Copper.
2. Main and Neutral Lugs: Mechanical type.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type.

D. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.


2.02 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Lugs only.

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.

2.03 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
4. Square D; a brand of Schneider Electric.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

PART 3 EXECUTION
3.01 EXAMINATION
A. Receive, inspect, handle, and store panelboards according to NECA 407.
B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
D. Proceed with installation only after unsatisfactory conditions have been corrected.
3.02 INSTALLATION
   A. Install panelboards and accessories according to NECA 407.
   B. Mount top of trim 90 inches above finished floor unless otherwise indicated.
   C. 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.
   D. Install filler plates in unused spaces.
   E. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.

3.03 IDENTIFICATION
   A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 26 05 53 "Identification for Electrical Systems."
   B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
   C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.04 ADJUSTING
   A. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
      1. Measure as directed during period of normal system loading.
      2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
      3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
      4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

END OF SECTION 26 24 16
SECTION 26 27 26
WIRING DEVICES

PART 1 GENERAL

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

1.02 SUMMARY
   A. Section Includes:
      1. Receptacles, receptacles with integral GFCI, and associated device plates.
      2. Snap switches.

1.03 ACTION SUBMITTALS
   A. Product Data: For each type of product.
   B. Shop Drawings: List of legends and description of materials and process used for premarking
      wall plates.

1.04 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For wiring devices to include in all manufacturers’
      packing-label warnings and instruction manuals that include labeling conditions.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following
      manufacturers' names are used in other Part 2 articles:
      1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
      2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
   B. Source Limitations: Obtain each type of wiring device and associated wall plate from single
      source from single manufacturer.

2.02 GENERAL WIRING-DEVICE REQUIREMENTS
   A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a
      qualified testing agency, and marked for intended location and application.
   B. Comply with NFPA 70.
   C. Devices that are manufactured for use with modular plug-in connectors may be substituted
      under the following conditions:
      1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
      2. Devices shall comply with the requirements in this Section.

2.03 STRAIGHT-BLADE RECEPTACLES
   A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6
      Configuration 5-20R, UL 498, and FS W-C-596.
      1. Products: Subject to compliance with requirements, provide one of the following:
         a. Cooper; 5351 (single), CR5362 (duplex).
         b. Hubbell; HBL5351 (single), HBL5352 (duplex).
         c. Leviton; 5891 (single), 5352 (duplex).
         d. Pass & Seymour; 5361 (single), 5362 (duplex).

2.04 GFCI RECEPTACLES
   A. General Description:
      1. Straight blade, feed-through type.
      2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; VGF20.
      b. Hubbell; GFR5352L.
      c. Pass & Seymour; 2095.
      d. Leviton; 7590.

2.05 TOGGLE SWITCHES
   A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
   B. Switches, 120/277 V, 20 A:
      1. Products: Subject to compliance with requirements, provide one of the following:
         a. Single Pole:
            1) Cooper; AH1221.
            2) Hubbell; HBL1221.
            3) Leviton; 1221-2.
            4) Pass & Seymour; CSB20AC1.
         b. Two Pole:
            (a) Cooper; AH1222.
            (b) Hubbell; HBL1222.
            (c) Leviton; 1222-2.
            (d) Pass & Seymour; CSB20AC2.
         c. Three Way:
            (a) Cooper; AH1223.
            (b) Hubbell; HBL1223.
            (c) Leviton; 1223-2.
            (d) Pass & Seymour; CSB20AC3.
         d. Four Way:
            (a) Cooper; AH1224.
            (b) Hubbell; HBL1224.
            (c) Leviton; 1224-2.
            (d) Pass & Seymour; CSB20AC4.
   C. Pilot-Light Switches, 20 A:
      1. Products: Subject to compliance with requirements, provide one of the following:
         a. Cooper; AH1221PL for 120 and 277 V.
         b. Hubbell; HBL1201PL for 120 and 277 V.
         c. Leviton; 1221-LH1.
         d. Pass & Seymour; PS20AC1RPL for 120 V, PS20AC1RPL7 for 277 V.
      2. Description: Single pole, with neon-lighted handle, illuminated when switch is "off."

2.06 WALL PLATES
   A. Single and combination types shall match corresponding wiring devices.
      1. Plate-Securing Screws: Metal with head color to match plate finish.
      2. Material for All Spaces: 0.035-inch-thick, satin-finished, Type 302 stainless steel.

2.07 FINISHES
   A. Device Color:
   B. Wall Plate Color: Stainless Steel
PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:
   1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
   2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
   3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
   4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:
   1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
   2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
   3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtailed.

D. Device Installation:
   1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
   2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
   3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
   4. Connect devices to branch circuits using pigtailed that are not less than 6 inches in length.
   5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
   6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
   7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtailed 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, multigang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.02 IDENTIFICATION

A. Comply with Section 26 05 53 "Identification for Electrical Systems."
B. Identify each receptacle and light switch with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with white-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

END OF SECTION 26 27 26
SECTION 26 28 13
FUSES

PART 1 GENERAL

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

1.02 SUMMARY
   A. Section Includes:
      1. Cartridge fuses rated 600-V ac and less for use in panelboards, control circuits, enclosed
         switches, enclosed controllers.
      2. Plug fuses rated 125-V ac and less for use in plug-fuse-type enclosed switches,
         fuseholders.
      4. Spare-fuse cabinets.

1.03 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated. Include construction details, material,
      dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include
      the following for each fuse type indicated:
      1. Dimensions and manufacturer's technical data on features, performance, electrical
         characteristics, and ratings.
      2. Fuse sizes for elevator feeders and elevator disconnect switches.

1.04 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For fuses to include in emergency, operation, and
      maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and
      Maintenance Data," include the following:
      1. Ambient temperature adjustment information.
      2. Current-limitation curves for fuses with current-limiting characteristics.

1.05 MAINTENANCE MATERIAL SUBMITTALS
   A. Furnish extra materials that match products installed and that are packaged with protective
      covering for storage and identified with labels describing contents.
      1. Fuses: Equal to 25 percent of quantity installed for each size and type, but no fewer than
         five of each size and type.

1.06 QUALITY ASSURANCE
   A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source
      from single manufacturer.
   B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70,
      by a qualified testing agency, and marked for intended location and application.
   C. Comply with NEMA FU 1 for cartridge fuses.
   D. Comply with NFPA 70.
   E. Comply with UL 248-11 for plug fuses.

1.07 COORDINATION
   A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size
      and with system short-circuit current levels.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Manufacturers: Subject to compliance with requirements, provide products by one of the
      following:
1. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.
3. Ferraz Shawmut, Inc.
4. Littelfuse, Inc.

2.02 CARTRIDGE FUSES
A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.03 PLUG FUSES
A. Characteristics: UL 248-11, nonrenewable plug fuses; 125-V ac.

2.04 PLUG-FUSE ADAPTERS
A. Characteristics: Adapters for using Type S, rejection-base plug fuses in Edison-base fuseholders or sockets; ampere ratings matching fuse ratings; irremovable once installed.

PART 3 EXECUTION
3.01 EXAMINATION
A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 FUSE APPLICATIONS
A. Cartridge Fuses:
   1. Motor Branch Circuits: Class RK1, time delay.
   2. Other Branch Circuits: Class RK1, time delay.
B. Plug Fuses:
   2. Other Branch Circuits: Edison-base type, single-element fast acting.

3.03 INSTALLATION
A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
B. Install plug-fuse adapters in Edison-base fuseholders and sockets. Ensure that adapters are irremovable once installed.
C. Install spare-fuse cabinet(s).

3.04 IDENTIFICATION
A. Install labels complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 26 28 13
SECTION 26 28 16
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Nonfusible switches.
   2. Molded-case circuit breakers (MCCBs).

1.03 DEFINITIONS
A. NC: Normally closed.
B. NO: Normally open.
C. SPDT: Single pole, double throw.

1.04 ACTION SUBMITTALS
A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component
   indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data
   on features, performance, electrical characteristics, ratings, accessories, and finishes.
   1. Enclosure types and details for types other than NEMA 250, Type 1.
   2. Current and voltage ratings.
   3. Short-circuit current ratings (interrupting and withstand, as appropriate).
   4. Include evidence of NRTL listing for series rating of installed devices.
   5. Detail features, characteristics, ratings, and factory settings of individual overcurrent
      protective devices, accessories, and auxiliary components.
B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations,
   sections, details, and attachments to other work.
   1. Wiring Diagrams: For power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in
   emergency, operation, and maintenance manuals. In addition to items specified in
   Section 01 78 23 "Operation and Maintenance Data," include the following:
   1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit
      breakers.

1.06 QUALITY ASSURANCE
A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective
   devices, components, and accessories, within same product category, from single source from
   single manufacturer.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70,
   by a qualified testing agency, and marked for intended location and application.
C. Comply with NFPA 70.

1.07 COORDINATION
A. Coordinate layout and installation of switches, circuit breakers, and components with equipment
   served and adjacent surfaces. Maintain required workspace clearances and required
   clearances for equipment access doors and panels.
PART 2 PRODUCTS

2.01 NONFUSIBLE SWITCHES
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
B. Basis-of-Design Product: Subject to compliance with requirements provide product by the following:
   1. Square D; a brand of Schneider Electric.
   2. General Electric
   3. Siemens
   4. Eaton
C. Type HD, Heavy Duty, Single Throw, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
D. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.02 MOLDED-CASE CIRCUIT BREAKERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
B. Basis-of-Design Product: Subject to compliance with requirements provide the following:
   1. Square D; a brand of Schneider Electric.
   2. General Electric
   3. Siemens
   4. Eaton
C. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
E. Features and Accessories:
   1. Standard frame sizes, trip ratings, and number of poles.
   2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
   3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.

2.03 ENCLOSURES
A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
   1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
   2. Outdoor Locations: NEMA 250, Type 3R.

PART 3 EXECUTION

3.01 EXAMINATION
A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
B. Proceed with installation only after unsatisfactory conditions have been corrected.
3.02 INSTALLATION
   A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
   B. Comply with mounting and anchoring requirements specified in Section 26 05 48.16 “Seismic Controls for Electrical Systems.”
   C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
   D. Install fuses in fusible devices.
   E. Comply with NECA 1.

3.03 IDENTIFICATION
   A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."
      1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
      2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.04 FIELD QUALITY CONTROL
   A. Tests and Inspections:
      1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
      2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   B. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

3.05 ADJUSTING
   A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
   B. Set field-adjustable circuit-breaker trip ranges

END OF SECTION 26 28 16
SECTION 26 29 23
VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 GENERAL

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

1.02 SUMMARY
A. Section includes separately enclosed, preassembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

1.03 DEFINITIONS
A. BAS: Building automation system.
B. CE: Conformite Europeene (European Compliance).
C. CPT: Control power transformer.
D. EMI: Electromagnetic interference.
E. LED: Light-emitting diode.
F. NC: Normally closed.
G. NO: Normally open.
H. OCPD: Overcurrent protective device.
I. PID: Control action, proportional plus integral plus derivative.
J. RFI: Radio-frequency interference.
K. VFC: Variable-frequency motor controller.

1.04 ACTION SUBMITTALS
A. Product Data: For each type and rating of VFC indicated.
   1. Include dimensions and finishes for VFCs.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
B. Shop Drawings: For each VFC indicated.
   1. Include mounting and attachment details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
      a. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and motor-circuit protector trip settings.
      b. Manufacturer's written instructions for setting field-adjustable overload relays.
      c. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
      d. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
      e. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.
Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.06 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ABB.
   2. Yaskawa.

2.02 SYSTEM DESCRIPTION

A. General Requirements for VFCs:
   1. VFCs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508A.

B. Application: variable torque.

C. VFC Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.
   1. Units suitable for operation of NEMA MG 1, Design A and Design B motors, as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
   2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
   3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

D. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

E. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.

F. Unit Operating Requirements:
   1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.
   2. Input AC Voltage Unbalance: Not exceeding 5 percent.
   3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
   4. Minimum Efficiency: 96 percent at 60 Hz, full load.
   5. Minimum Displacement Primary-Side Power Factor: 96 percent under any load or speed condition.
   6. Minimum Short-Circuit Current (Withstand) Rating: 22 kA.
   7. Ambient Temperature Rating: Not less than 32 deg F and not exceeding 104 deg F.
   8. Humidity Rating: Less than 95 percent (noncondensing).
   11. Overload Capability: 1.5 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
   12. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
13. Speed Regulation: Plus or minus 10 percent.
14. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.
15. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.

G. Inverter Logic: Microprocessor based, 16 bit, isolated from all power circuits.

H. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.

I. Internal Adjustability Capabilities:
   1. Minimum Speed: 5 to 25 percent of maximum rpm.
   2. Maximum Speed: 80 to 100 percent of maximum rpm.
   3. Acceleration: 0.1 to 999.9 seconds.
   4. Deceleration: 0.1 to 999.9 seconds.
   5. Current Limit: 30 to minimum of 150 percent of maximum rating.

J. Self-Protection and Reliability Features:
   1. Surge Suppression: Factory installed as an integral part of the VFC, complying with UL 1449 SPD, Type 1 or Type 2.
   2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
   4. Inverter overcurrent trips.
   5. VFC and Motor-Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
   6. Critical frequency rejection, with three selectable, adjustable deadbands.
   7. Instantaneous line-to-line and line-to-ground overcurrent trips.
   10. Short-circuit protection.
   11. Motor-overtemperature fault.
   12. Line reactors.
   13. Load reactors as required for proper motor function based on conductor length between VFC and controlled load.

K. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

L. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.

M. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

N. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

O. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

P. Integral Input Disconnecting Means and OCPD: UL 489, instantaneous-trip circuit breaker with pad-lockable, door-mounted handle mechanism.
   1. Disconnect Rating: Not less than 115 percent of VFC input current rating.
   2. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.
3. Auxiliary Contacts: NO or NC, arranged to activate before switch blades open.

2.03 CONTROLS AND INDICATION

A. Status Lights: Door-mounted LED indicators displaying the following conditions:
   1. Power on.
   2. Run.
   3. Overvoltage.
   4. Line fault.
   5. Overcurrent.

B. Panel-Mounted Operator Station: Manufacturer’s standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
   1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.

C. Historical Logging Information and Displays:
   1. Real-time clock with current time and date.
   2. Running log of total power versus time.
   3. Total run time.
   4. Fault log, maintaining last four faults with time and date stamp for each.

D. Indicating Devices: Digital display mounted flush in VFC door and connected to display VFC parameters including, but not limited to:
   1. Output frequency (Hz).
   5. Motor torque (percent).
   6. Fault or alarming status (code).
   7. PID feedback signal (percent).
   8. DC-link voltage (V dc).
   9. Set point frequency (Hz).
   10. Motor output voltage (V ac).

E. Control Signal Interfaces:
   1. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BAS or other control systems:
      a. 4- to 20-mA dc.
      b. Potentiometer using up/down digital inputs.
      c. Fixed frequencies using digital inputs.
   2. Output Signal Interface: A minimum of one programmable analog output signal(s) (4- to 20-mA dc), which can be configured for any of the following:
      a. Output frequency (Hz).
      b. Output current (load).
      c. DC-link voltage (V dc).
      d. Motor torque (percent).
      e. Motor speed (rpm).
      f. Set point frequency (Hz).
   3. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
      a. Motor running.
      b. Set point speed reached.
      c. Fault and warning indication (overtemperature or overcurrent).
      d. PID high- or low-speed limits reached.
F. BAS Interface: Factory-installed hardware and software shall interface with BAS to monitor, control, display, and record data for use in processing reports. VFC settings shall be retained within VFC's nonvolatile memory.
   1. Communication Interface: Comply with ASHRAE 135. Communication shall interface with BAS to remotely control and monitor lighting from a BAS operator workstation. Control features and monitoring points displayed locally at lighting panel shall be available through the BAS.

2.04 BYPASS SYSTEMS
A. Bypass Operation: Safely transfers motor between power converter output and bypass circuit, manually, automatically, or both. Selector switches set modes and indicator lights indicate mode selected. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter.
B. Bypass Mode: Field-selectable automatic or manual, allows local and remote transfer between power converter and bypass contactor and retransfer, either via manual operator interface or automatic-control system feedback.

2.05 ENCLOSURES
A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.
   1. Dry and Clean Indoor Locations: Type 1.

2.06 SOURCE QUALITY CONTROL
A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.
   1. Test each VFC while connected to its specified motor.
   2. Verification of Performance: Rate VFCs according to operation of functions and features specified.
B. VFCs will be considered defective if they do not pass tests and inspections.
C. Prepare test and inspection reports.

PART 3 EXECUTION
3.01 EXAMINATION
A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.
B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.
C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.
D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work
E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION
A. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 26 05 29 "Hangers and Supports for Electrical Systems."
B. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
C. Comply with NECA 1.
3.03 IDENTIFICATION

A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each VFC with engraved nameplate.
   3. Label each enclosure-mounted control and pilot device.

B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.04 FIELD QUALITY CONTROL

A. Manufacturer’s Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections with the assistance of a factory-authorized service representative.

C. Acceptance Testing Preparation:
   1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

D. Tests and Inspections:
   1. Inspect VFC, wiring, components, connections, and equipment installation.
   2. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect before starting the motor(s).
   3. Test each motor for proper phase rotation.
   5. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

E. VFCs will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.05 STARTUP SERVICE

A. Perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions

3.06 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

3.07 PROTECTION

A. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.08 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

END OF SECTION 26 29 23
SECTION 26 51 00
LIGHTING

PART 1 GENERAL

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

1.02 SUMMARY
   A. Section Includes:
      1. Lighting fixtures, lamps, and ballasts.
      2. Emergency lighting units.
      3. Exit signs.
      4. Lighting fixture supports.
   B. Related Sections:
      1. Section 26 09 23 "Lighting Control Devices" for automatic control of lighting, including time
         switches, photoelectric relays, occupancy sensors, and multipole lighting relays and
         contactors.

1.03 DEFINITIONS
   A. BF: Ballast factor.
   B. CCT: Correlated color temperature.
   C. CRI: Color-rendering index.
   D. LER: Luminaire efficacy rating.
   E. Lumen: Measured output of lamp and luminaire, or both.
   F. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.04 ACTION 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. Emergency lighting units including battery and charger.
      3. Ballast, including BF.
      5. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
         a. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's
            laboratory with a current accreditation under the National Voluntary Laboratory
            Accreditation Program for Energy Efficient Lighting Products.
   B. Shop Drawings: For nonstandard or custom lighting fixtures. Include plans, elevations,
      sections, details, and attachments to other work.
      1. Detail equipment assemblies and indicate dimensions, weights, loads, required
         clearances, method of field assembly, components, and location and size of each field
         connection.
      2. Wiring Diagrams: For power, signal, and control wiring.
   C. Installation instructions.

1.05 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency,
      operation, and maintenance manuals.
      1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.
1.06 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, by a qualified testing agency, and marked for intended location and application.
C. Comply with NFPA 70.

1.07 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.

1.08 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 Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
   2. Warranty Period for Self-Powered Egress Light Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

PART 2 PRODUCTS
2.01 MANUFACTURERS
A. Products: Subject to compliance with requirements, provide product indicated on Drawings.

2.02 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS
A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
B. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
C. Metal Parts: Free of burrs and sharp corners and edges.
D. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
F. Diffusers and Globes:
   1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
      a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
      b. UV stabilized.
   2. Glass: Annealed crystal glass unless otherwise indicated.
G. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
   1. Label shall include the following lamp and ballast characteristics:
      a. "USE ONLY" and include specific lamp type.
b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.

c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.

d. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.

e. ANSI ballast type (M98, M57, etc.) for HID luminaires.

f. CCT and CRI for all luminaires.

2.03 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Standards:
   1. ENERGY STAR certified.
   2. California Title 24 compliant.
   3. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
   4. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
   5. UL Listing: Listed for damp location.
   6. Recessed luminaires shall comply with NEMA LE 4.

C. CRI of minimum 80. CCT of 4100 K.

D. Rated lamp life of 50,000 hours to L70.

E. Lamps dimmable from 100 percent to 0 percent of maximum light output.

F. Internal driver.

G. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

H. Housings:
   1. Extruded-aluminum housing and heat sink.
   2. Clear powder-coat finish.

2.04 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
   1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.

2.05 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.


E. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

F. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 EXECUTION

3.01 INSTALLATION

A. Lighting fixtures:
1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
2. Install lamps in each luminaire.

B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

C. Remote Mounting of Ballasts: Distance between the ballast and fixture shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.

D. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.
   1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from lighting fixture corners.
   2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
   3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

E. Suspended Lighting Fixture Support:
   1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
   3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
   4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

3.02 IDENTIFICATION
A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 26 05 53 “Identification for Electrical Systems.”

3.03 FIELD QUALITY CONTROL
A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 26 51 00
SECTION 27 00 00
GENERAL REQUIREMENTS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Division 27 Specifications are provided to define the standards and criteria to be used to bid, plan, furnish, install, test, and document communication systems for Ankeny Community School District Parkview Middle School. These specifications shall form the basis for implementation of the procurement, installation, inspection, and close-out process.

B. Division 27 has been designed and developed based on NFPA 70 (NEC), National Electrical Safety Code (NESC), Institute of Electronic and Electrical Engineers (IEEE), and a combination of ANSI/TIA Telecommunication Standards, and BICSI methodologies. The requirements within those documents are not superseded herein unless specifically stated. NEC and NESC code requirements are unable to be superseded by this document at any time. ANSI/TIA standards and BICSI methodologies are guidelines and recommendations for best practices and may be superseded, as specified, or may be made more stringent by this document.

C. Any use of the word “shall” marks a mandatory requirement. Use of the word “may” or “should” suggests optional elements. All conflicts within this document shall be resolved by the General Contractor in consultation with the Design Team. The standards of XYZ Corporation shall take precedence in the resolution of any dispute.

D. Unauthorized changes and/or deviations from these specifications, regardless of scale, may result in re-design, reconstruction, or re-installation of communications elements at the contractor's expense. Contractors shall obtain formal written approval prior to bidding and prior to installation in order to deviate from these specifications or from ANSI/TIA standards and BICSI methodologies. Contractors shall not deviate from NEC and NESC requirements.

E. Division 27 Specifications address information transport pathways, multiple different types of communication systems, spaces, media, grounding, identification, testing, and documentation requirements in support of multiple information transport infrastructures.

F. Specific responsibilities of Division 27 include, but are not limited to:
   1. Installation of the intra-building pathways, cabling, and coordinating space requirements necessary to house the communication systems and associated electronic information transport equipment. Pathways and spaces shall be provided to support the known systems and cabling requirements, as well as provisions for those that may be required in the future for growth purposes.
   2. The procurement and installation of each communications system and the associated components and cabling to create a fully functional system.
   3. Thorough testing shall be conducted of each individual communications system to illustrate compliance with specific performance requirements.
   4. Definition and establishment of administration and labeling schemes, conforming to Owner’s requirements.
   5. Securing all necessary permits and licenses, payment of all fees, and provision of all construction work notifications.
   6. Compliance with all applicable laws, ordinances, rules, and regulations.
   7. Mandatory project manager attendance at a weekly project status meeting with the Construction Manager.
   8. It is the intent of the project drawings and specifications to provide complete and fully functional Division 27 communication systems, ready for use. Any item, not specifically shown in the project drawings or called for in the project specifications but normally required for a complete system, is to be considered a part of this contract.

G. System Continuity:
   1. Reconnect all existing items that remain in use. Provide all materials and labor required to retain continuity of existing circuits or systems that are disrupted by these alterations even though not indicated on the drawings.
1.02 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 & 01 Specification Sections, apply to this Section.

B. The following documents shall also be considered as a part of and shall relate directly to this section:
   1. Section 27 15 13 - COMMUNICATIONS COPPER HORIZONTAL CABLING

1.03 ABBREVIATIONS AND ACRONYMS

A. The following definitions are applicable to the work as indicated and as shown herein:
   1. ACR: Attenuation-to-Crosstalk Ration
   2. ADA: Americans with Disabilities Act
   3. AFF: Above Finished Floor
   4. ANSI: American National Standards Institute
   5. ASTM: American Society for Testing & Materials (ASTM International)
   6. AWG: American Wire Gauge
   8. BTU: British Thermal Unit
   9. dB: Decibel
   10. dBmV: Decibel MilliVolt
   11. EF: Entrance Facility
   12. EIA: Electronic Industries Association
   13. ELFEXT: Equal Level Far-End Crosstalk
   14. EMC: Electromagnetic Compatibility
   15. EMI: Electromagnetic Interference
   16. EMT: Electrical Metallic Tubing
   17. ER: Equipment Room
   18. FCC: Federal Communications Commission
   19. FD: Floor Distributor
   20. FEXT: Far-End Crosstalk
   22. F/UTP: Overall foil screened cable with unshielded twisted pair.
   23. FTP: Shielded twisted pair.
   24. Freq: Frequency
   25. HC: Horizontal Cross-Connect
   26. HVAC: Heating, Ventilation, and Air Conditioning
   27. Hz: Hertz
   28. IC: Intermediate Cross-Connect
   29. IDC: Insulation Displacement Connector
   30. IDF: Intermediate Distribution Frame
   31. IEEE: Institute of Electrical and Electronics Engineers
   32. ISO: International Organization for Standardization
   33. LAN: Local Area Network
   34. LCD: Liquid Crystal Display
   35. Mbps: Megabits per second
   36. MC: Main Cross-Connect
   37. MDF: Main Distribution Frame
   38. MHz: Megahertz
   39. NEC: National Electrical Code, NFPA 70
   41. NFPA: National Fire Protection Association
   42. NRTL: Nationally Recognized Testing Laboratory
   43. OSHA: Occupational Safety and Health Administration
   44. OSP: Outside cable Plant
45. PR: Pair
46. RCDD: Registered Communications Distribution Designer
47. xRFI: Radio Frequency Interference
48. S/FTP: Overall braid screened cable with foil screened twisted pair
49. S/UTP: Overall braid screened cable with unshielded twisted pair
50. SE: Service Entrance
51. TIA: Telecommunications Industry Association
52. TO: Telecommunications Outlet
53. TR: Telecommunications Room
54. TV: Television
55. UL: Underwriters Laboratory
56. UPS: Uninterruptible Power Supply
57. WAO: Work Area Outlet
58. WAP: Wireless Access Point
59. UTP: Unshielded Twisted Pair

1.04 DEFINITIONS

A. The following definitions are applicable to the work as indicated and as shown herein:

1. Attenuation: The decrease in power of a signal, light beam, or lightwave, either absolutely or as a fraction of a reference value. Attenuation is the opposite of gain and is measured in decibels (dB).

2. Backbone System: The cabling and connecting hardware that provides interconnection between Telecommunications Rooms, Equipment Room, and Entrance Facilities.

3. Conduit Chase Pipe: Short section of bushed EMT conduit with sufficient size and capacity to support horizontal cabling bundles from ceiling space, through ceiling tile, onto the ladder tray system connecting wall to rack or cabinet.

4. Cross Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

5. Design Team: A group of individuals comprised of Architect(s) and Engineer(s) involved in assembling the contract documents known as the drawings and specifications.

6. Duct Bank: Two or more ducts in parallel, with or without additional casing materials.

7. EF: Entrance facility - A location within a building for both public and private network service cables. A facility that provides all necessary mechanical and electrical services for the entry of telecommunications cables into a building and that complies with all relevant regulations. Also referred to as SE: Service Entrance.

8. ER: Equipment Room - A centralized space designed for telecommunications equipment that serves the occupants of a building. Equipment therein is considered distinct from an IDF (Telecommunications Room) because of its nature or complexity. Also frequently referred to as MCR or MDF.

9. Horizontal System: The cabling between, and including, the TO (Telecommunications Outlet) connector and the HC (Horizontal Cross-connect) in the Telecommunications Room.

10. HC: Horizontal Cross-Connect - A group of connectors, such as patch panel or punchdown block, that allows equipment and backbone cabling to be cross-connected with patch cords or jumpers. Floor Distributor (FD) is the international term for HC. Also frequently referred to as IDF.

11. Jack: Also commonly called an "outlet", it is the fixed, female connector.

12. J-Hook: A supporting device for horizontal cables that is shaped like a "J". It is attached to some building structures. Horizontal cables are laid in the opening formed by the "J" to provide support for cables.

13. Minor Pathway Support Hardware: Anchors, support brackets, clamps, clips, cable ties, D-rings, rack screws, velcro straps and etc. used to dress and secure cabling, conduits and surface raceways.

14. Plug: Also commonly called a "connector", it is the removable, male telecommunications connector.
15. RF: Radio Frequency - The area (or band) of the electromagnetic spectrum where most radio communication takes place, typically from 100 KHz to 100 GHz. A frequency at which coherent electromagnetic radiation of energy is useful for communication purposes. Analog electrical signals sent on cable or over the air. Conventional (broadcast) television and radio, as well as cable TV, deliver RF signals to your television/radio.

16. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

17. SE: Service Entrance - An entrance to a building for both public and private network service cables. A facility that provides all necessary mechanical and electrical services for the entry of telecommunications cables into a building and that complies with all relevant regulations. Also referred to as EF: Entrance Facility.

18. Shield: A metallic layer, either a foil or braid, placed around a group of conductors.

19. Splice: A joining of conductors meant to be permanent. A device that joins conducting or transmitting media. Also referred to as straight splice.

20. TE: Telecommunications Enclosure - A case or housing for telecommunications cable terminations and cross-connect cabling.

21. TO: Telecommunications Outlet - A device placed at the user workstation for termination of horizontal media and for connectivity of network equipment. Also referred to as WAO (Work Area Outlet).

22. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

23. WAO: Work Area Outlet - A device placed at the user workstation for termination of horizontal media and for connectivity of network equipment. Also referred to as TO (Telecommunications Outlet).

1.05 CODE REFERENCES AND STANDARDS

A. All work shall be in compliance with the following codes and agencies. Nothing contained within these specifications shall be misconstrued to permit work not in conformance with the most stringent of applicable codes and standards. It is assumed that bidders have access to, and specific knowledge of, the listed reference materials in order to ensure conformity with them.

1. National Electrical Code (NEC)
3. National Fire Protection Association (NFPA)
4. International Building Code (IBC)
5. Iowa Administrative Code
6. Federal, State, and Local Codes.
7. National Electronic Manufacturer’s Association (NEMA)
8. Institute of Electronic and Electrical Engineers (IEEE)
10. Occupational Safety & Health Administration (OSHA)
11. Federal Communications Commission (FCC)

B. All new materials, equipment, and installation practices shall meet the requirements of the following standards, unless specifically instructed otherwise by the Design Team.

1. TIA-568.0-D - Generic Telecommunications Cabling for Customer Premises (September 2015)
2. TIA-568.1-D - Commercial Building Telecommunications Infrastructure Standard (September 2015)
3. TIA-568-C.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standards (August 2009)
4. TIA-569-D - Telecommunications Pathways and Spaces (April 2015)
5. TIA-606-B - Administration Standard for Telecommunications Infrastructure (December 2015)
6. NFPA 70 - National Electric Code (NEC)
7. BICSI - Telecommunications Distribution Methods Manual 13th, or most recent, edition.
8. BICSI - Information Transport Systems Installation Manual 7th, or most recent, edition
a. Perform all work in accordance with local jurisdiction requirements that is governing the work and as fully part of the specifications attached.

1.06 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation of the telephone and internet service provider pathway and entrance with the Electrical Contractor and the Owner's selected carrier.

B. All Division 27 Contractor Project Managers shall schedule and conduct a coordination meeting with XYZ Corporation Information Technology Department to confirm and coordinate scope of work requirements prior to commencement of work. Project meetings shall be scheduled through the Construction Manager.

1.07 SUBMITTALS

A. Refer to Division 1 for exact submittal procedures.

B. The Division 27 Contractor shall provide for review, without exception prior to material acquisition and installation, the following items. Failure to submit required items shall disqualify the bidder.
   1. Product Data Sheets (Catalog Cuts)
   2. Cabling Diagram
   3. System Schematics
   4. Signal Flow Diagram
   5. Dimensioned plans, sections and elevations and fabrication details.
   6. Specification Sheets for Test Equipment
   7. Bill of Materials
   8. Contracting Firm Qualifications and Certifications
   9. Installation Team Qualifications by Individual
   10. Current Manufacturer Certifications

C. Provide throughout installation:
   1. Material samples, if requested by the design team.
   2. Periodic field quality control reports.
   3. Periodic system test reports.
   4. Periodic cable test reports.

D. Provide prior to completion:
   1. Actual samples of labeling to be applied to cabling components, to be approved by the Design Team and Construction Manager.
   2. Cable data base listing patch panel station cable assignments. Database shall be provided on compact disc or other electronic media format when requested by the Construction Manager, XYZ Corporation or the Design Team. Database shall be submitted to the requesting party within seven (7) calendar days.
   3. Cable administration drawings, as requested to assist in the planning process. Drawings will be requested prior to final documentation.

E. Provide at completion of each construction phase area:
   1. Cable test and certification reports; summary hard copy or full test results on compact disc when requested by the owner or design team. Reports shall be submitted to the requesting party within seven (7) calendar days.
   2. One (1) set of record drawings of the actual installation of the Division 27 systems. Drawings shall be given as full size originals and on disk in AutoCAD format

F. Provide at final completion Closeout Submittals. This shall consist of three (3) bound sets of O&M (Operating and Maintenance) Manuals formatted as defined by Division 1 and one (1) electronic copy provided on a CD/DVD disc. Each copy of the O&M Manual shall include, at minimum, items listed as follows:
   1. Cable test and certification reports; summary hard copy and full test results on disc. Test results shall be delivered at the completion of each project phase and at any time when called for by the Owner.
2. Provide one (1) full-size hard copy set of record drawings (as-builts) to be submitted to the Design Team for approval, immediately upon completion of the installation.
3. Instruction manuals including equipment and schedules, operating instructions, and manufacturer's instructions.
4. Manufacturer Warranty Certificate.
   a. Warranty contacts including but not limited to: names, telephone numbers (office and mobile).

1.08 QUALITY ASSURANCE

A. Contracting firm shall constitute a company with a minimum of five (5) years successful installation experience with projects utilizing infrastructure and systems work similar to that required for this project.

B. Service Qualifications: Installing and servicing contractor shall have a permanent office within a 120 mile radius of the project site.

C. Cabling Contractor shall have at least one (1) Registered Communications Distribution Designer and installers with Installer-level BICSI Certifications on staff responsible for this project. Provide copies of these certificates in the submittal process.

D. Work crew, not involved in installing cable elements (e.g. laborers delivering/moving materials, installing grounding by an electrician, or workers installing pathway elements) do not require BICSI or manufacturer certification or registration.

E. Contractor shall provide a Manufacturer Certification for the system solution bid, issued directly in the bidder’s company name, valid for the time frame in which the installation will be completed. Contractor shall be manufacturer certified in order to participate in the bid event.

F. The contractor shall be knowledgeable in local, state, regional, and national codes and regulations. All work shall comply with the latest revision of codes or regulations. When conflict exists between local or national codes or regulations, the most stringent codes or regulations shall apply.

G. Only installers trained and certified by the proposed manufacturer shall be allowed to install products. Installers must possess the highest level of certification available by the manufacturer for the specific solution being installed.

H. Only installers trained and certified by the proposed manufacturer shall be allowed to install firestop products.

I. Before bidding, the contractor shall study and compare all contract documents and promptly notify the Design Team of any discrepancies or deficiencies discovered by or made known to the contractor.

J. Discrepancies: Whenever a discrepancy or inconsistency exists between related information indicated on the contract drawings and/or specifications, this contractor shall obtain additional clarification and direction from the Design Team before proceeding. For bidding purposes, this contractor shall include the labor and materials necessary to comply with the solution that results in the greatest cost to the contract.
   1. If there is a conflict between applicable documents, then the more stringent requirement shall apply.
   2. The failure to question any controversial item will constitute acceptance by the bidder who shall execute it to the satisfaction of the owner after being awarded the contract.

K. Deficiencies: The contractor and associated subcontractors shall resolve all known deficiencies and omissions, including non-compliance with applicable codes, with the Design Team prior to ordering materials or proceeding with the work. Any work performed prior to receipt of instructions from the Design Team will be done so at the contractor's risk.
   1. If mention has been omitted pertaining to details, items or related accessories required for the completion of any system, it is understood such item and accessories are included in the contract. After the contract is awarded, claims based on insufficient data or incorrectly assumed conditions, or claims based on misunderstanding the nature of the work, will not be recognized.
2. All devices, symbols and work illustrated shall be new work provided under this contract except work labeled existing to remain and equipment labeled to be furnished (or supplied) by others, but installed by this contractor.

1.09 DELIVERY, STORAGE, AND HANDLING
A. Equipment, materials, and supplies shall be shipped, handled and stored in ways that shall prevent damage to the items.
B. All items shall be handled and stored as recommended by the manufacturer.
C. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to assure that products are maintained under manufacturer's specified conditions, and free from damage or deterioration.
D. Equipment, materials, and supplies to be incorporated in the area of work shall be new unless otherwise specified.
E. Equipment, materials, and supplies shall be produced in a good workmanlike manner.
F. When the quality of a material, process, or article is not specifically set forth in the Drawings or Specifications, the best available quality of the material, process, or article shall be provided.

1.10 FIELD CONDITIONS
A. Conditions and Measurements: Visit the jobsite to verify installation conditions and confirm measurements for all required systems and associated cabling connectivity.

1.11 WARRANTY
A. The Contractor shall submit, in the bid documents, any additional contractor-specific warranties or guarantees to be offered on the project.
B. The Contractor shall supply any and all necessary documentation needed to process and record the warranty(s) and to verify the installation solution.
C. Data Cabling System Warranty
   1. All cabling systems shall include a minimum ten (10) year application assurance warranty as a manufacturer registered system installation. During the warranty period, and for non-conformities of which contractor has notice, contractor shall take all necessary and appropriate action; free of charge, to correct any non-conformity with the warranties contained in the manufacturer agreement. During the warranty period, contractor shall provide to the Owner, free of costs and charges, all support necessary to ensure that the cabling system meets the requirements specified in this document and performance guarantees provided by the contractors. During the warranty period, contractors shall furnish, or cause to be furnished, all maintenance, service, parts and replacements necessary to maintain the cabling system in good working condition, at no cost to the Owner.
   2. The contractor shall supply a full manufacturer's application assurance warranty for all new installations, to include approved termination hardware and cabling media from the proposed manufacturer's list of approved materials. Services to be provided by this contractor to the Owner during the warranty period shall include, without limitation, the following:
      a. Remedial Maintenance
         1) Contractor shall provide service on the Owner's site as necessary including, but not limited to, fault isolation, diagnosis, and repair.
      b. Maintenance Records
         1) Contractor shall maintain, at the jobsite, a current record of the cabling system configuration.
      c. Replacement Parts
         1) Contractor shall provide and install replacement parts, including new components.
D. All Other Communications Systems Warranty
1. Unless listed elsewhere within these specifications, a warranty shall be provided for a minimum of one (1) year for all other communications systems listed. One year shall begin from the date of Substantial Completion. This warranty shall cover both product and service to address remedial maintenance and replacement parts as is appropriate to keep each system complete and fully functional.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. If a Bidder proposes to Substitute an article, device, material, equipment, form of construction, fixture, or item other than the approved manufacturers and part numbers, listed and named in the Specifications, the Bidder shall certify that the proposed item is equal in quality and all aspects of performance and appearance, to the items specified. The Bidder shall submit a request for Substitution to the Design Team by following the instruction in Specification Section 01 6000, which must include:
   1. The name and complete description of the proposed Substitution including Drawings, performance and test data, and other information necessary for a complete evaluation; and
   2. A statement setting forth any changes that the Proposed Substitution will require in the Contract Documents or the project.

B. If the Design Team approves the Proposed Substitution, the Design Team shall issue an Addendum. If the Design Team does not approve the substitution, the Design Team shall inform the Bidder of its decision, which is final. The Design Team may reject a proposed Substitution because the Bidder failed to provide sufficient information to enable the Design Team to completely evaluate the Proposed Substitution without causing a delay in the scheduled bid opening.
   1. Proposed Substitutions received by the Design Team after the allotted time allowed by Section 01 6000 shall not be considered.

C. Bidder shall confirm all reference part numbers, listed within Division 27, as current and suitable for the items described and specified and shall file a formal RFI for all perceived discrepancies prior to bidding.
   1. All materials associated with reference parts shall be included so as to constitute a complete and functional system, whether or not specifically identified and itemized.

2.02 ASSEMBLIES

A. Sleeves and Pathways for Cabling:
   1. Where additional conduits are needed beyond those shown on the drawings to accommodate the installation of systems cabling, this contractor (Division 27) shall include such provisions in this contract. Provide conduit suitable for its application and sized in accordance with industry standards. Include nylon bushings at conduit ends and firestopping as required around conduits wherever building barriers are penetrated. If necessary, this contractor shall hire a qualified contractor to perform this work.

PART 3 - EXECUTION

3.01 CLEANING

A. Division 27 Contractor shall thoroughly clean all assemblies within the telecommunications room’s space before they are turned over to the XYZ Corporation IT Services for operation. Cleaning shall include, but not be limited to, all ladder tray, racks and wire managers (both inside and out), copper and optical fiber panels (both inside and out). Should any telecommunications room or closet be completed prior to the balance of the floor space construction that it serves, racks, cabinets, and wall frames shall be covered with plastic sheeting to repel dust and other contaminants to which they will be subjected.

3.02 PROJECT CONDITIONS

A. The active information transport system and cabling associated with specific work beyond the construction area shall not be disrupted at any time.
B. Contractor shall clean work areas each day and remove debris properly and legally from the project site. Materials and supplies stored for use in the project shall be neatly stacked outside the circulation areas. All exits and paths shall be cleaned so as to prevent dirt from being tracked into the site.

C. It shall be the responsibility of the Contractor to secure any parking permits prior to the first day of work on-site.

D. Work outside of normal operating hours and days shall be coordinated with XYZ Corporation.

3.03 SAFETY REQUIREMENTS

A. All contract work shall be performed in accordance with the policies, procedures, and standards established by the Owner.

B. In construction areas, all Contractor personnel shall wear personnel protection devices, as deemed appropriate by the Construction Manager and as required by OSHA for the work location and work operation being performed. Devices shall include, but not be limited to hardhats, work boots, safety eye protection, reflective vests, etc.

C. All exposed holes, pits, pipes, etc., either inside or outside the project site, shall be barricaded or plated and adequately secured when Contractor personnel are not present. All ladders, hanging wires, pipes, and other items protruding at a pedestrian level travel way most be removed or secured following the final shift of the day.

D. During breaks or when only a portion of work has been completed, tools shall not be left exposed where others may risk injury or attempt to use them. Windows and doors shall not be left unsecured or propped open during breaks. At the completion of the final shift each day, doors, windows, or other openings shall be adequately secured.

E. When driving on the Owner's property, Contractor personnel shall observe all traffic safety regulations and pay particular attention to pedestrians. All loose material and debris on vehicles shall be adequately secured and tied down.

END OF SECTION 27 00 00
PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Category 6a twisted pair cable.
   2. Twisted pair cable hardware, including plugs and jacks.
   3. Coaxial Cabling
   4. Grounding and bonding.
   5. Labeling.

B. Description:
   1. Horizontal cable cabling system shall provide interconnections between the floor distributor and the equipment outlet, otherwise known as “Cabling Subsystem,” in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.
   a. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
   b. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
   c. Bridged taps and splices shall not be installed in the horizontal cabling.
   2. A work area is approximately 100 sq. ft. (9.3 sq. m), and includes the components that extend from the equipment outlets to the station equipment.
   3. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment or in the horizontal cross-connect.

1.02 RELATED REQUIREMENTS

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

B. The following documents shall also be considered as a part of and shall relate directly to this section:
   1. Section 270000 - GENERAL REQUIREMENTS FOR COMMUNICATIONS SYSTEMS

1.03 ABBREVIATIONS AND ACRONYMS

A. Reference Section 270000 - GENERAL REQUIREMENTS FOR COMMUNICATIONS SYSTEMS

1.04 DEFINITIONS

A. Reference Section 270000 - GENERAL REQUIREMENTS FOR COMMUNICATIONS SYSTEMS

1.05 CODE REFERENCES AND STANDARDS

A. Comply with Section 270000 - GENERAL REQUIREMENTS FOR COMMUNICATIONS SYSTEMS

1.06 SUBMITTALS

A. Comply with Section 270000 - GENERAL REQUIREMENTS FOR COMMUNICATIONS SYSTEMS

1.07 QUALITY ASSURANCE

A. Comply with Section 270000 - GENERAL REQUIREMENTS FOR COMMUNICATIONS SYSTEMS
1.08 DELIVERY, STORAGE, AND HANDLING
   A. Reference Section 270000 - GENERAL REQUIREMENTS FOR COMMUNICATIONS SYSTEMS

1.09 WARRANTY
   A. Comply with Section 270000 - GENERAL REQUIREMENTS FOR COMMUNICATIONS SYSTEMS

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS
   A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.
   B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.
   C. Grounding: Comply with TIA-607-C.

2.02 GENERAL CABLE CHARACTERISTICS
   A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:
      1. Communications, Plenum Rated: Type CMP complying with UL 1685 or Type CMP in listed plenum communications raceway or Type CMP in listed cable routing assembly.
   B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      1. Flame-Spread Index: 25 or less.
      2. Smoke-Developed Index: 50 or less.
   C. RoHS compliant.

2.03 CATEGORY 6A TWISTED PAIR CABLE
   A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6a cable at frequencies up to 500MHz.
   B. Standard: Comply with TIA-568-C.2 for Category 6a cables.
   C. Conductors: 100-ohm, 23 AWG solid copper.
   D. Shielding/Screening: Unshielded twisted pairs (UTP).
   E. Cable Rating: Plenum.
   F. Jacket: Blue thermoplastic.

2.04 TWISTED PAIR CABLE HARDWARE
   A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.
   B. General Requirements for Twisted Pair Cable Hardware:
      1. Comply with the performance requirements of Category 6a.
      2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
      3. Cables shall be terminated with connecting hardware of same category or higher.
   C. Source Limitations: Obtain twisted pair cable hardware from same manufacturer as twisted pair cable, from single source.
   D. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.
      1. Features:
         a. Universal T568A and T568B wiring labels.
         b. Labeling areas adjacent to conductors.
         c. Replaceable connectors.
         d. 24 or 48 ports.
      2. Construction: 16-gauge steel and mountable on 19-inch (483 mm) equipment racks.
3. Number of Jacks per Field: One for each four-pair cable indicated, plus spares and blank positions adequate to suit specified expansion criteria.

E. Patch Cords: Factory-made, four-pair cables in 48-inch (1200-mm) lengths; terminated with an eight-position modular plug at each end.
   1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.
   2. Patch cords shall have color-coded boots for circuit identification.

F. Plugs and Plug Assemblies:
   1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
   3. Marked to indicate transmission performance.

G. Jacks and Jack Assemblies:
   1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
   2. Designed to snap-in to a patch panel or faceplate.
   4. Marked to indicate transmission performance.

H. Faceplate:
   1. Four-port, vertical single gang faceplates designed to mount to single gang wall boxes.
   2. Eight-port, vertical double gang faceplates designed to mount to double gang wall boxes.
   4. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.
      a. Flush mounting jacks, positioning the cord at a 45-degree angle.

I. Legend:
   1. Machine printed, in the field, using adhesive-tape label.
   2. Snap-in, clear-label covers and machine-printed paper inserts.

2.05 COAXIAL CABLEING

A. Approved Manufacturers:
   1. CommScope
   2. Carol Brand/General Cable
   3. Belden

B. General Cable Characteristics:
   1. Performance Requirements:
      a. General Performance: Backbone cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard, and the requirements of TIA-568-C.4
      b. Telecommunications Pathways and Spaces: Comply with TIA-569-D.
   2. Communication Cable: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:
      a. Communications, Plenum Rated: Type CMP complying with UL 1685.
      b. Communications, Plenum Rated: Type CM, Type CMG, Type CMP, Type CMR, or Type CMX in metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
   3. CATV Cable: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 50 for the following types:
      a. CATV Plenum Rated: Type CATVP, complying with NFPA 262.
      b. CATV Cable: Type CATV in fireproof riser shafts with firestops at each penetration.

C. Communications Coaxial Cable
   1. Description: Coaxial cable with a 75-ohm characteristic impedance designed for broadband data transmission.
2. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 13, and with NFPA 70, "Class 1, Class 2, Class 3 Remote-Control, Signaling, and Power-Limited Circuits" and "Communications Circuits" articles. Types are as follows:
   a. RG-6/U: UL Type CMP and CL2P.
      1) No. 16 and 18 AWG, solid, copper-covered steel conductor.
      2) Plenum rated.
      3) Gas-injected, foam-PE insulation.
      4) Shielded with 100 percent aluminum tape and 40 and 60 percent aluminum braid.
      5) Double shielded with 100 aluminum foil shield, 60 percent aluminum braided inner shield, and 40 percent aluminum braided outer shield.
      6) Jacketed with black and white PVC or PE.
      7) Suitable for indoor installations.
   b. RG-11/U: UL Type CMP and CL2P.
      1) No. 14 AWG, solid, copper-covered steel conductor.
      2) Plenum rated. Suitable for outdoor installations in ambient temperatures ranging from minus 40 to plus 85 deg C.
      3) Gas-injected, foam-PE insulation.
      4) Shielded with 100 percent aluminum tape and 40 and 60 percent aluminum braid.
      5) Double shielded with 100 aluminum foil shield, 60 percent aluminum braided inner shield, and 40 percent aluminum braided outer shield.
      6) Jacketed with sunlight-resistant, black and white PVC or PE.
   c. RG-59/U: UL Type CMP and CL2P.
      1) No. 20 AWG, solid copper conductor.
      2) Plenum rated.
      3) Gas-injected, foam-PE insulation.
      4) Single shielded with 100 percent aluminum shield and 40 percent aluminum braid.
      5) PVC jacket.
3. **CATV Coaxial Cable**
   a. Description: Coaxial cable with a 75-ohm characteristic impedance designed for CATV transmission.
   b. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 13, and with NFPA 70, "Class 1, Class 2, Class 3 Remote-Control, Signaling, and Power-Limited Circuits" and "Communications Circuits" articles. Types are as follows:
      1) RG-6/U: UL Type CATVP.
         (a) No. 18 AWG, solid, copper-covered steel conductor.
         (b) Plenum rated.
         (c) Gas-injected, foam-PE insulation.
         (d) Shielded with 100 percent aluminum tape and 40 and 60 percent aluminum braid.
         (e) Double shielded with 100 aluminum foil shield, 60 percent aluminum braided inner shield, and 40 percent aluminum braided outer shield.
         (f) Jacketed with black and white PVC or PE.

2.06 **COAXIAL CABLING HARDWARE**
   A. Description: Hardware designed to connect, splice, and terminate coaxial cable with a 75-ohm characteristic impedance.
   B. Coaxial-Cable Connectors: Type BNC, 75 ohms.
   C. Jacks and Jack Accessories: Modular, color-coded, with female Type BNC connectors.
D. Patch Cords: Factor-made cables in 48-inch lengths, terminated with a male Type BNC connector at each end.

E. Faceplates:
   1. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 - WIRING DEVICES.
   2. For use with snap-in jacks accommodating any combination of twisted pair, optical-fiber, and coaxial work area cords.
      a. Flush-mounted jacks, positioning the cord at a 90-degree angle from faceplate surface.
   3. Legend:
      a. Factory labeled by silk-screening or engraving for stainless steel faceplates.
      b. Machine printed, in the field, using adhesive-tap label.
      c. Snap-in, clear-label covers and machine-printed paper inserts.

2.07 GROUNDING AND BONDING
   A. Comply with requirements in Section 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS for grounding conductors and connectors.
   B. Comply with TIA-607-C.

2.08 IDENTIFICATION PRODUCTS
   A. Comply with requirements in Section 270553 - IDENTIFICATION FOR COMMUNICATIONS SYSTEMS.
   B. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 EXECUTION

3.01 WIRING METHODS
   A. Wiring Method: Install cables in raceways and cable trays, except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, attics, and gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables, except in unfinished spaces.
      1. Install plenum cable in environmental air spaces, including plenum ceilings.
      2. Comply with requirements for raceways and boxes specified in Section 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS.
   B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
   C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools. Install conductors parallel with or at right angles to sides and back of enclosure.

3.02 INSTALLATION OF PATHWAYS
   A. Comply with Section 270536 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS
   B. Drawings indicate general arrangement of pathways and fittings.

3.03 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES
   A. Comply with NECA 1 and NECA/BICSI 568.
   B. General Requirements for Cabling:
      1. Comply with TIA-568-C.0, TIA-568-C.1, and TIA-568-C.2.
      3. Do not untwist twisted pair cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.

5. Consolidation points may be used only for making a direct connection to equipment outlets:
   a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
   b. Locate consolidation points for twisted-pair cables at least 49 feet (15 m) from communications equipment room.

6. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

7. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.

8. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.

9. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.

10. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

11. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.


C. Open-Cable Installation:
   1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
   2. Suspend twisted pair cabling, not in a wireway or pathway, a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
   3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

D. Group connecting hardware for cables into separate logical fields.

E. Separation from EMI Sources:
   1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.
   2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
      a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
      b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
      c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).
   3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
      a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
      b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
      c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
   4. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).

6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.04 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."


3.05 GROUNDING

A. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."

B. Comply with TIA-607-B and NECA/BICSI-607.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall, allowing at least a 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar to suitable electrical building ground, using a minimum No. 4 AWG grounding electrode conductor.

D. Bond metallic equipment to the grounding bus bar, using not smaller than a No. 6 AWG equipment grounding conductor.

3.06 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

1. Administration Class: Class 1.

2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 1 level of administration.

C. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

E. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.

3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).

4. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.

a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from a panel or cabinet to a building-mounted device, with the name and number of a particular device.
b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

F. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:
1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.07 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.
1. Tests and Inspections:
   a. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
   b. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
   c. Test twisted pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
      1) Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
   D. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.
   E. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
   F. End-to-end cabling will be considered defective if it does not pass tests and inspections.
   G. Prepare test and inspection reports.

END OF SECTION 27 15 13
SECTION 28 46 00
FIRE DETECTION AND ALARM

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Fire alarm system design and installation, including all components, wiring, and conduit.
B. Replacement and removal of existing fire alarm system components, wiring, and conduit indicated.

1.02 RELATED REQUIREMENTS
A. Section 23 33 00 - Air Duct Accessories: Smoke dampers monitored and controlled by fire alarm system.

1.03 REFERENCE STANDARDS
A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Evidence of designer qualifications.
C. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:
   1. Copy (if any) of list of data required by authority having jurisdiction.
   2. NFPA 72 “Record of Completion”, filled out to the extent known at the time.
   3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A-7-5-2.2(9), and complete listing of software required.
   4. System zone boundaries and interfaces to fire safety systems.
   5. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming.
   6. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.
   7. List of all devices on each signaling line circuit, with spare capacity indicated.
   8. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
   9. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
10. Certification by either the manufacturer of the control unit or by the manufacturer of each other component that the components are compatible with the control unit.
11. Certification by the manufacturer of the control unit that the system design complies with Contract Documents.
12. Certification by Contractor that the system design complies with Contract Documents.
13. Do not show existing components to be removed.
D. Evidence of installer qualifications.
E. Inspection and Test Reports:
   1. Submit inspection and test plan prior to closeout demonstration.
   2. Submit documentation of satisfactory inspections and tests.
   3. Submit NFPA 72 “Inspection and Test Form,” filled out.
F. Operating and Maintenance Data: See Section 01 78 00 for additional requirements; revise and resubmit until acceptable; have one set available during closeout demonstration:
1. Complete set of specified design documents, as approved by authority having jurisdiction.
2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
3. Contact information for firm that will be providing contract maintenance and trouble call-back service.
4. List of recommended spare parts, tools, and instruments for testing.
5. Replacement parts list with current prices, and source of supply.
6. Detailed troubleshooting guide and large scale input/output matrix.
7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.
8. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.

G. Project Record Documents: See Section 01 78 00 for additional requirements; have one set available during closeout demonstration:
   1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
   2. "As installed" wiring and schematic diagrams, with final terminal identifications.
   3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.

H. Closeout Documents:
   1. Certification by manufacturer that the system has been installed in compliance with manufacturer's installation requirements, is complete, and is in satisfactory operating condition.
   2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: NICET Level III or IV (3 or 4) certified fire alarm technician or registered fire protection engineer, employed by fire alarm control panel manufacturer, Contractor, or installer, with experience designing fire alarm systems in the jurisdictional area of the authorities having jurisdiction.

B. Installer Qualifications: Firm with minimum 3 years documented experience installing fire alarm systems of the specified type and providing contract maintenance service as a regular part of their business.
   1. Authorized representative of control unit manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
   2. Installer Personnel: At least 2 years of experience installing fire alarm systems.
   3. Supervisor: NICET level III or IV (3 or 4) certified fire alarm technician; furnish name and address.

1.06 WARRANTY

A. Provide control panel manufacturer's warranty that system components other than wire and conduit are free from defects and will remain so for 1 year after date of Substantial Completion.

B. Provide installer's warranty that the installation is free from defects and will remain so for 1 year after date of Substantial Completion.

PART 2 PRODUCTS

2.01 FIRE ALARM SYSTEM

A. Fire Alarm System: Provide modifications and extensions to the existing automatic fire detection and alarm system:
   1. Provide all components necessary, regardless of whether shown in Contract Documents or not.
2. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
   a. The requirements of the local authority having jurisdiction, which is the City of Ankeny.
   b. Applicable local codes.
   c. Contract Documents (drawings and specifications).
   d. NFPA 72; where the word "should" is used consider that provision mandatory; where conflicts between requirements require deviation from NFPA 72, identify deviations clearly on design documents.

B. Circuits:
   1. Initiating Device Circuits (IDC): Class B, Style A.
   2. Signaling Line Circuits (SLC) Within Single Building: Class B, Style 0.5.

2.02 EXISTING COMPONENTS
A. Clearly label components that are "Not In Service."
B. Remove unused existing components and materials from site and dispose of properly.

2.03 FIRE SAFETY SYSTEMS INTERFACES
A. Alarm: Provide alarm initiation in accordance with NFPA 72 for the following:
   1. Duct smoke detectors.
B. HVAC:
   1. Duct Smoke Detectors: Close dampers indicated; shut down air handlers indicated.

2.04 COMPONENTS
A. General:
   1. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
   2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.
B. Initiating Devices:
   1. Addressable Systems:
      a. Addressable Devices: Individually identifiable by addressable fire alarm control unit.
      b. Provide suitable addressable interface modules as indicated or as required for connection to conventional (non-addressable) devices and other components that provide a dry closure output.
   2. Duct Smoke Detectors: ________.
C. Circuit Conductors: Copper or optical fiber; provide 200 feet extra; color code and label.

PART 3 EXECUTION
3.01 INSTALLATION
A. Install in accordance with applicable codes, NFPA 72, NFPA 70, and Contract Documents.
B. Conceal all wiring, conduit, boxes, and supports where installed in finished areas.
C. Obtain Owner's approval of locations of devices, before installation.
D. Install instruction cards and labels.

3.02 INSPECTION AND TESTING FOR COMPLETION
A. Notify Owner 7 days prior to beginning completion inspections and tests.
B. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.
C. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.
D. Prepare for testing by ensuring that all work is complete and correct; perform preliminary tests as required.
E. Provide all tools, software, and supplies required to accomplish inspection and testing.

F. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.

G. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

3.03 CLOSEOUT

A. Closeout Demonstration: Demonstrate proper operation of all functions to Owner.
   1. Be prepared to conduct any of the required tests.
   2. Have at least one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
   3. Have authorized technical representative of control unit manufacturer present during demonstration.
   4. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.
   5. Repeat demonstration until successful.

END OF SECTION 28 46 00