



GIBSON, MANCINI, CARMICHAEL & NELSON
115 E. LAUREL ST ■ GARDEN CITY, KS 67846 ■ P: (620) 276-3244 ■ www.gmcnarchitects.com

SAFETY & SECURITY UPGRADES TO WILEY ELEMENTARY, HOLCOMB ELEMENTARY, & HOLCOMB MIDDLE SCHOOL UNIFIED SCHOOL DISTRICT #363

305 Wiley Street
Holcomb, KS 67851

Project No. 201721

April 16, 2018

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PROJECT MANUAL / SPECIFICATIONS

Document Issue Date: April 16th, 2018

USD 363 Holcomb - Bid Package #1

Additions & Renovations

Location of Project:

Wiley Elementary, 304 S. Henderson, Holcomb, KS 67851

Holcomb Elementary, 200 N. Main St., Holcomb, KS 67851

Holcomb Middle School, 500 N. Henderson St., Holcomb, KS 67851

Bid Due Date: May 3rd, 2018 at 2:00 PM CST

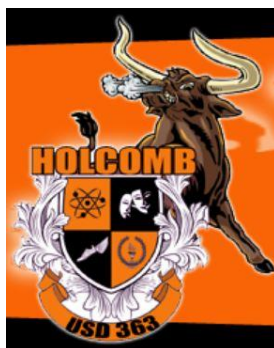
(unless modified by addendum)

Owner: USD 363 Holcomb, 305 Wiley St., P.O. Box #8, Holcomb, KS 67851

Architect: GMCN Architects PA, 115 E. Laurel, Garden City, KS 67846

CMAR: Coonrod & Associates Construction Co., Inc.,

3550 S. Hoover Rd., Wichita, KS 67215



SECTION 00 01 01 - PROJECT TITLE PAGE

PROJECT MANUAL

SAFETY AND SECURITY UPGRADES TO USD 363 HOLCOMB SCHOOLS

UNIFIED SCHOOL DISTRICT #363

305 WILEY STREET

HOLCOMB, KANSAS 67851



DATE: APRIL 16, 2018

ARCHITECT PROJECT NO. 201721

PREPARED BY:

GIBSON, MANCINI, CARMICHAEL & NELSON, P.A.

115 EAST LAUREL STREET

GARDEN CITY, KANSAS 67846

PHONE: 620-276-3244

FAX: 620-276-6249

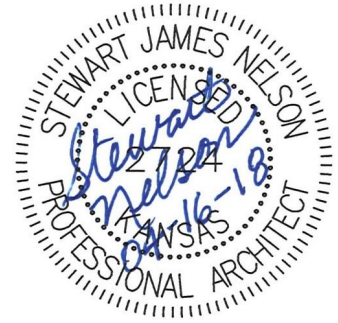
WEB SITE: WWW.GMCNARCHITECTS.COM

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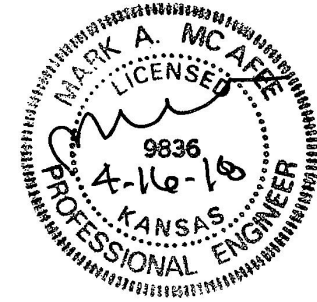
SECTION 00 01 07 - SEALS PAGE

1.1 DESIGN PROFESSIONALS OF RECORD

ARCHITECT
Stewart Nelson
License No. 2724
Divisions 01 Thru 13 & 30-33



STRUCTURAL
ENGINEER
Mark McAfee
License No. 9836
Divisions 03, 04, 05 & 31



MECHANICAL
ENGINEER
Shaun Conway
License No. 19761
Divisions 21, 22, & 23



ELECTRICAL
ENGINEER
Hoang V. Vo
License No. 23143
Divisions 26, 27, & 28



END OF SECTION

SECTION 00 01 15 - LIST OF DRAWING SHEETS

1.1 LIST OF DRAWINGS

A. Drawings consist of the Contract Drawings and other drawings listed on the Table of Contents page of the separately bound drawings titled: **SAFETY AND SECURITY UPGRADES TO WILEY ELEMENTARY SCHOOL, HOLCOMB ELEMENTARY SCHOOL & HOLCOMB MIDDLE SCHOOLS, Unified School District #363, 305 Wiley Street, Holcomb, Kansas**, dated April 16, 2018 as modified by subsequent Addenda and Contract Modifications.

B. List of Drawings: Drawings consist of the following Contract Drawings and other drawings of type indicated:

1.G100, G101, G102, G103, AS101, AD100, A100, A101, A101.1, A101.2, A102, A103, A201, A301, A310, A400, A401, A501, A601, S001, S101, S201, S301, S401, S402, M0.1, M1.1, M2.1, M2.2, M3.1, E0.1, E0.2, E1.1, E2.1, E2.2, E2.3, E4.1, E4.2, E5.1, E6.1, E6.2 & E6.3

END OF SECTION

Instructions To Bidders

USD 363 Holcomb Schools - Bid Package #1 Additions & Renovations

Date: 4/17/2018

Construction Manager:

Randy Coonrod, Project Lead	Coonrod & Associates	randyc@coonrod.com	P: 316-942-8430
Justin Parks, Project Manager	Coonrod & Associates	justinp@coonrod.com	P: 316-942-8430 C: 316-516-0990
Levi Eaton, Project Superintendent	Coonrod & Associates	levie@coonrod.com	C: 316-617-4472
Niki Parks, Assistant to PM's	Coonrod & Associates	nikip@coonrod.com	P: 316-942-8430

Architect: Nick Nemechek, Assoc. AIA GMCN Architects nnemechek@gmcnarchitects.com
P: 620-276-3244

Bid Date

Time

USD 363 Holcomb Schools - Bid Package #1 Additions & Renovations

5/3/2018

2:00:00 PM, CST

Pre-Bid **Non-Mandatory Pre-Bid / Walk Through:** **Following Pre-Bid Conference**

- Pre Bid Location: USD 363 Holcomb District Office, 305 Wiley St., Holcomb, KS. (Located in the conference room.)

Bidding Procedures: Public bid opening - Base bid prices will be read aloud.

1. Hand Delivered. Bids can be turned in at:

**USD 363 Holcomb District Office, 305 Wiley St.,
Holcomb, KS**

2. Faxed Bids are acceptable. Please send to the fax number **(316) 942-0257**

3. Emailed bids are acceptable. Please email to nikip@coonrod.com.

**FAXED OR EMAILED BIDS MUST RECEIVE VERBAL OR EMAIL ACKNOWLEDGEMENT OF RECEIPT
CALL 316-942-8430**

The owner, architect and construction manager will review the bids and determine the lowest, responsible bidder. The owner, architect, and/or the construction manager reserve the right to reject any and/or all bids.

**Late bids will not be considered.

Please use bid form provided.

There will be a bid scope sheet issued by addendum. Please review and bid accordingly. Bid Proposal Scope may be attached to the Bid Form.



Instructions To Bidders

Plans: www.gradebeam.com
<http://www.coonrod.com/holcomb/>
Kansas Construction News Report- Wichita, KS
****Addenda only sent to bidders receiving plans from Gradebeam.**
****Addenda will be available on Coonrod Site shortly after received by the design team.**

Bonding: No Bid Bond Required.
Successful subcontract bidders over \$50,000 require Performance & Payment Bonds
Do not include the price of the P&P bond in the base bid. Reference the Bid Form.

Sales Tax: Exempt

Alternates: None - Unless added by Addendum.

Unit Prices: None - Unless added by Addendum.

Testing & Special Inspections: Per plans / specifications

Submittals: Via Submittal Exchange

Miscellaneous Items:

1. All questions/RFI's pre-bid and during construction must be sent in writing. Please send to justinp@coonrod.com.
2. All subs/suppliers are responsible for having material delivered on time and have crews ready to go per the CM's schedule. There will be no added compensation for overtime work only unless there are circumstances out of the subcontractor's/supplier's control.
3. Each subcontractor is required to provide enough manpower to meet the schedule and your bid should reflect this accordingly.
4. **Each subcontractor / supplier is to make sure that materials can and will arrive on time per the schedule BEFORE BIDDING.**
5. There will be no added compensation after the bid for accelerating the delivery time.

SECTION 00 25 13 - PREBID MEETINGS

PREBID MEETING

1.01 ARCHITECT (ON BEHALF OF THE OWNER) WILL CONDUCT A PREBID MEETING AS INDICATED BELOW:

- A. Meeting Date: April 25, 2018.
 - 1. Meeting Time: 2:30 p.m., local time.
 - 2. Location: Board Room, Holcomb Schools, 305 Wiley Street, Holcomb, Kansas, 67851.
- B. Attendance:
 - 1. Subcontractors: Attendance at Prebid meeting is highly recommended.
- C. Bidder Questions: Submit written questions to be addressed at Prebid meeting minimum of two business days prior to meeting.
- D. Agenda: Prebid meeting agenda will include review of topics that may affect proper preparation and submittal of bids, including the following:
 - 1. Procurement and Contracting Requirements:
 - a. Advertisement for Bids.
 - b. Instructions to Bidders.
 - c. Bidder Qualifications.
 - d. Bonding.
 - e. Insurance.
 - f. Bid Security.
 - g. Bid Form and Attachments.
 - h. Bid Submittal Requirements.
 - i. Bid Submittal Checklist.
 - j. Notice of Award.
 - 2. Communication during Bidding Period:
 - a. Obtaining documents.
 - b. Access to Project Web site.
 - c. Bidder's Requests for Information.
 - d. Bidder's Substitution Request/Prior Approval Request.
 - e. Addenda.
 - 3. Contracting Requirements:
 - a. Agreement.
 - b. The General Conditions.
 - c. The Supplementary Conditions.
 - d. Other Owner requirements.
 - 4. Construction Documents:
 - a. Scopes of Work.
 - b. Temporary Facilities.
 - c. Use of Site.
 - d. Work Restrictions.
 - e. Alternates, Allowances, and Unit Prices.
 - f. Substitutions following award.
 - 5. Schedule:
 - a. Project Schedule.
 - b. Contract Time.

- c. Liquidated Damages.
- d. Other Bidder Questions.
- 6. Site/facility visit or walkthrough.
- 7. Post-Meeting Addendum.
- E. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes to attendees and others known by the issuing office to have received a complete set of Procurement and Contracting Documents. Minutes of meeting are issued as Available Information and do not constitute a modification to the Procurement and Contracting Documents. Modifications to the Procurement and Contracting Documents are issued by written Addendum only.
 - 1. Sign-in Sheet: Minutes will include list of meeting attendees.
 - 2. List of Planholders: Minutes will include list of planholders.

END OF DOCUMENT 002513

SECTION 00 31 43 - PERMIT APPLICATION

PERMIT APPLICATION INFORMATION

1.01 THIS DOCUMENT WITH ITS REFERENCED ATTACHMENTS IS PART OF THE PROCUREMENT AND CONTRACTING REQUIREMENTS FOR PROJECT. THEY PROVIDE OWNER'S INFORMATION FOR BIDDERS' CONVENIENCE AND ARE INTENDED TO SUPPLEMENT RATHER THAN SERVE IN LIEU OF THE BIDDERS' OWN INVESTIGATIONS. THIS DOCUMENT AND ITS ATTACHMENTS ARE NOT PART OF THE CONTRACT DOCUMENTS.

- A. Permit Application: Complete building permit application and file with authorities having jurisdiction within five days of the Notice to Proceed.
- B. Permit Application: The building permit for the Project shall be applied for by the Construction Company.

END OF DOCUMENT 003143

Sub-Contract / Material Supplier Bid Form

USD 363 Holcomb Schools
Bid Package #1
Additions & Renovations
Holcomb, KS

Project:

Architect: GMCN Architects Inc.
Structural Engineer: Dudley Williams & Associates, PA
MEP Engineer: Professional Engineering Consultants
Construction Manager: Coonrod & Associates Construction Co., Inc.

Date: _____

Bidder Company Name: _____

Bidder Address: _____

Bidder Contact Name: _____

Scope of Work / Bid Scope (Reference Bid Scopes issued by CM):
Scope clarifications may be attached to this bid form.

Base Bid:

In compliance with the Instructions to Bidders, plans, specifications / project manual and any and all addenda for this project, the undersigned agrees to fully furnish all material and equipment and perform all labor for above scope of work and/or bid package designated, for the lump sum of

_____ Dollars

(\$ _____)

Unit Prices: N/A

Bonding:

Performance and Payment Bonds are required for bids over \$50,000.00. Do not include in Base Bid.

Bond Amount To Be Added \$ _____

Completion Time:

The Bidder agrees to commence Work on the date of a written 'Notice to Proceed' following execution of the Owner/Contractor Agreement and to substantially complete all Work by:

Renovation : 8/13/2018

Addition : 2/1/2019

SECTION 00 50 00 - CONTRACTING FORMS AND SUPPLEMENTS

PART 1 GENERAL

1.01 **CONTRACTOR IS RESPONSIBLE FOR OBTAINING A VALID LICENSE TO USE ALL COPYRIGHTED DOCUMENTS SPECIFIED BUT NOT INCLUDED IN THE PROJECT MANUAL.**

1.02 **AGREEMENT AND CONDITIONS OF THE CONTRACT**

- A. See Section 00 52 00 - Agreement Form for the Agreement form to be executed.
- B. See Section 00 72 00 - General Conditions for the General Conditions.
- C. The Agreement is based on AIA A101.
- D. The General Conditions are based on AIA A201.

1.03 **FORMS**

- A. Use the following forms for the specified purposes unless otherwise indicated elsewhere in the Contract Documents.

1.04 **REFERENCE STANDARDS**

- A. AIA A101 - Standard Form of Agreement Between Owner and Contractor where the basis of Payment is a Stipulated Sum; 2007.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 10 00 - SUMMARY

PART 1 GENERAL

1.01 PROJECT

- A. Project Name: Safety and Security Upgrades to USD 363 Holcomb Schools
- B. Owner's Name: Unified School District #363.
- C. Architect's Name: Gibson, Mancini, Carmichael & Nelson Architects.
- D. The Project consists of the Construction and Remodeling of Safety and Security upgrades including a new storm shelter at Holcomb Elem. School, HVAC upgrades, Doors and window replacements..

1.02 CONTRACT DESCRIPTION

- A. Contract Type: A single prime contract based on a Stipulated Price as described in Document 00 52 00 - Agreement Form.

1.03 DESCRIPTION OF ALTERATIONS WORK

- A. Scope of demolition and removal work is indicated on drawings and specified in Section 02 41 00.
- B. Owner will remove the following items before start of work:
 - 1. All Loose Furniture and Fixtures.

1.04 OWNER OCCUPANCY

- A. Owner intends to continue to occupy adjacent portions of the existing building during the entire construction period.
- B. Owner intends to occupy the Project during construction..
- C. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- D. Schedule the Work to accommodate Owner occupancy.

1.05 CONTRACTOR USE OF SITE AND PREMISES

- A. Construction Operations: Limited to areas noted on Drawings.
- B. Arrange use of site and premises to allow:
 - 1. Owner occupancy.
 - 2. Work by Others.
- C. Provide access to and from site as required by law and by Owner:
 - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
 - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.
- D. Existing building spaces may not be used for storage.
- E. Time Restrictions:
 - 1. Limit conduct of especially noisy exterior work to the hours of 8:00 a.m. to 5:00 p.m. If projects occur during the school year. If projects occur during summer break hours can be negotiated with owner.

F. Utility Outages and Shutdown:

1. Limit disruption of utility services to hours the building is unoccupied.
2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.
3. Prevent accidental disruption of utility services to other facilities.

END OF SECTION

SECTION 01 30 00 - ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General administrative requirements.
- B. Electronic document submittal service.
- C. Preconstruction meeting.
- D. Site mobilization meeting.
- E. Progress meetings.
- F. Construction progress schedule.
- G. Progress photographs.
- H. Coordination drawings.
- I. Submittals for review, information, and project closeout.
- J. Number of copies of submittals.
- K. Submittal procedures.

1.02 GENERAL ADMINISTRATIVE REQUIREMENTS

- A. Conform to requirements of Section 01 70 00 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.

1.03 PROJECT COORDINATION

- A. Project Coordinator: Construction Manager.
- B. Cooperate with the Project Coordinator in allocation of mobilization areas of site; for field offices and sheds, for site access, traffic, and parking facilities.
- C. During construction, coordinate use of site and facilities through the Project Coordinator.
- D. Comply with Project Coordinator's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
- E. Comply with instructions of the Project Coordinator for use of temporary utilities and construction facilities.
- F. Coordinate field engineering and layout work under instructions of the Project Coordinator.
- G. Make the following types of submittals to Architect through the Project Coordinator:
 - 1. Requests for interpretation.
 - 2. Requests for substitution.
 - 3. Shop drawings, product data, and samples.
 - 4. Test and inspection reports.
 - 5. Design data.
 - 6. Manufacturer's instructions and field reports.
 - 7. Applications for payment and change order requests.
 - 8. Progress schedules.
 - 9. Coordination drawings.

10. Correction Punch List and Final Correction Punch List for Substantial Completion.
11. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

- A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF) format and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
 1. Besides submittals for review, information, and closeout, this procedure applies to requests for information (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
 2. Contractor and Architect are required to use this service.
 3. It is Contractor's responsibility to submit documents in PDF format.
 4. Subcontractors, suppliers, and Architect's consultants will be permitted to use the service at no extra charge.
 5. Users of the service need an email address, Internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
 6. Paper document transmittals will not be reviewed; emailed PDF documents will not be reviewed.
 7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.

3.02 PRECONSTRUCTION MEETING

- A. Project Coordinator will schedule a meeting after Notice of Award.
- B. Attendance Required:
 1. Owner.
 2. Architect.
 3. Contractor.
 4. Major subcontractors.
- C. Agenda:
 1. Execution of Owner-Contractor Agreement.
 2. Submission of executed bonds and insurance certificates.
 3. Distribution of Contract Documents.
 4. Submission of list of Subcontractors, list of Products, schedule of values, and progress schedule.
 5. Designation of personnel representing the parties to Contract, _____ and Architect.
 6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 7. Scheduling.

- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.03 PROGRESS MEETINGS

- A. Project Coordinator will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- B. Attendance Required:
 - 1. Contractor.
 - 2. Owner.
 - 3. Architect.
 - 4. Contractor's Superintendent.
 - 5. Major Subcontractors.
- C. Agenda:
 - 1. Review minutes of previous meetings.
 - 2. Review of Work progress.
 - 3. Field observations, problems, and decisions.
 - 4. Identification of problems that impede, or will 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.
- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 CONSTRUCTION PROGRESS SCHEDULE

- A. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- B. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
 - 1. Include written certification that major contractors have reviewed and accepted proposed schedule.
- C. Within 10 days after joint review, submit complete schedule.
- D. Submit updated schedule with each Application for Payment.

3.05 PROGRESS PHOTOGRAPHS

- A. Submit new photographs at least once a month, within 3 days after exposure.
- B. Photography Type: Digital; electronic files.
- C. Provide photographs of site and construction throughout progress of Work produced by an experienced photographer, acceptable to Architect.
- D. In addition to periodic, recurring views, take photographs of each of the following events:

1. Completion of site clearing.
 2. Excavations in progress.
 3. Foundations in progress and upon completion.
 4. Structural framing in progress and upon completion.
 5. Enclosure of building, upon completion.
 6. Final completion, minimum of ten (10) photos.
- E. Views:
1. Provide non-aerial photographs from four cardinal views at each specified time, until date of Substantial Completion.
 2. Consult with Architect for instructions on views required.
 3. Provide factual presentation.
 4. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.
- F. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
1. Delivery Medium: Via email.
 2. File Naming: Include project identification, date and time of view, and view identification.
 3. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.

3.06 COORDINATION DRAWINGS

- A. Review drawings prior to submission to Architect.

3.07 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit them for review:
1. Product data.
 2. Shop drawings.
 3. Samples for selection.
 4. Samples for verification.
- B. Submit to Architect for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
- C. Samples will be reviewed only for aesthetic, color, or finish selection.
- D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 78 00 - Closeout Submittals.

3.08 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit them for information:
1. Design data.
 2. Certificates.
 3. Test reports.
 4. Inspection reports.
 5. Manufacturer's instructions.
 6. Manufacturer's field reports.
 7. Other types indicated.

- B. Submit for Architect's knowledge as contract administrator or for Owner. No action will be taken.

3.09 SUBMITTALS FOR PROJECT CLOSEOUT

- A. Submit Correction Punch List for Substantial Completion.
- B. Submit Final Correction Punch List for Substantial Completion.
- C. When the following are specified in individual sections, submit them at project closeout:
 - 1. Project record documents.
 - 2. Operation and maintenance data.
 - 3. Warranties.
 - 4. Bonds.
 - 5. Other types as indicated.
- D. Submit for Owner's benefit during and after project completion.

3.10 NUMBER OF COPIES OF SUBMITTALS

- A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
- B. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
 - 1. After review, produce duplicates.
 - 2. Retained samples will not be returned to Contractor unless specifically so stated.

3.11 SUBMITTAL PROCEDURES

- A. Shop Drawing Procedures:
 - 1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting the Contract Documents and coordinating related Work.
 - 2. Generic, non-project specific information submitted as shop drawings do not meet the requirements for shop drawings.
- B. Transmit each submittal with a copy of approved submittal form.
- C. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.
- D. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.
- E. 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 the requirements of the Work and Contract Documents.
- F. Schedule submittals to expedite the Project, and coordinate submission of related items.
- G. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
- H. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.
- I. Provide space for Contractor and Architect review stamps.

- J. When revised for resubmission, identify all changes made since previous submission.
- K. Distribute reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.
- L. Submittals not requested will not be recognized or processed.

END OF SECTION

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Submittals.
- B. References and standards.
- C. Control of installation.
- D. Testing and inspection agencies and services.
- E. Control of installation.
- F. Manufacturers' field services.
- G. Defect Assessment.

1.02 RELATED REQUIREMENTS

- A. Section 01 42 19 - Reference Standards.

1.03 REFERENCE STANDARDS

- A. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2014).
- B. ASTM C1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation; 2014.
- C. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2013.
- D. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2012a.
- E. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection and/or Testing; 2014a.
- F. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2013.
- G. IAS AC89 - Accreditation Criteria for Testing Laboratories; 2010.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Testing Agency Qualifications:
 - 1. Prior to start of Work, submit agency 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 NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
- C. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
 - 1. Include:
 - a. Date issued.
 - b. Project title and number.

- c. Name of inspector.
 - d. Date and time of sampling or inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.
 - g. Type of test/inspection.
 - h. Date of test/inspection.
 - i. Results of test/inspection.
 - j. Conformance with Contract Documents.
 - k. When requested by Architect, provide interpretation of results.
- D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
- 1. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- E. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
- 1. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.

1.05 REFERENCES AND STANDARDS

1.06 TESTING AND INSPECTION AGENCIES AND SERVICES

- A. Contractor shall employ and pay for services of an independent testing agency to perform specified soil compaction testing. All concrete testing shall be furnished by the Owner.
- B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- C. Contractor Employed Agency:
 - 1. Testing agency: Comply with requirements of ASTM E329, ASTM E543, ASTM C1021, ASTM C1077, ASTM C1093, ASTM D3740, and _____.
 - 2. Inspection agency: Comply with requirements of ASTM D3740, ASTM E329, and _____.
 - 3. Laboratory Qualifications: Accredited by IAS according to IAS AC89.
 - 4. Laboratory: Authorized to operate in the State in which the Project is located.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 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. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect 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. Have Work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 TESTING AND INSPECTION

- A. Testing Agency Duties:
 - 1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
 - 2. Perform specified sampling and testing of products in accordance with specified standards.
 - 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 - 4. Promptly notify Architect and Contractor of observed irregularities or non-conformance of Work or products.
 - 5. Perform additional tests and inspections required by Architect.
 - 6. Submit reports of all tests/inspections specified.
- B. Limits on Testing/Inspection Agency Authority:
 - 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 - 2. Agency may not approve or accept any portion of the Work.
 - 3. Agency may not assume any duties of Contractor.
 - 4. Agency has no authority to stop the Work.
- C. Contractor Responsibilities:
 - 1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
 - 2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
 - 3. Provide incidental labor and facilities:
 - a. To provide access to Work to be tested/inspected.
 - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
 - c. To facilitate tests/inspections.
 - d. To provide storage and curing of test samples.
 - 4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
 - 5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
 - 6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- D. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Architect.

- E. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.

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

3.04 DEFECT ASSESSMENT

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

END OF SECTION

SECTION 01 42 19 - REFERENCE STANDARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements relating to referenced standards.

1.02 QUALITY ASSURANCE

- A. For products or workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference 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 of date of issue specified in this section, except where a specific date is established by applicable code.
- C. Obtain copies of standards when required by the Contract Documents.
- D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Date of Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, request clarification from the Architect before proceeding.
- F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of the Architect shall be altered by the Contract Documents by mention or inference otherwise in any reference document.

PART 2 CONSTRUCTION INDUSTRY ORGANIZATION DOCUMENTS

2.01 AA -- ALUMINUM ASSOCIATION, INC.

2.02 AABC -- ASSOCIATED AIR BALANCE COUNCIL

2.03 AAMA -- AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION

2.04 ABMA -- AMERICAN BEARING MANUFACTURERS ASSOCIATION, INC.

2.05 AFPA -- AMERICAN FOREST AND PAPER ASSOCIATION

2.06 AGC -- ASSOCIATED GENERAL CONTRACTORS OF AMERICA

2.07 AHA -- AMERICAN HARDBOARD ASSOCIATION

2.08 AIA -- THE AMERICAN INSTITUTE OF ARCHITECTS

2.09 AISC -- AMERICAN INSTITUTE OF STEEL CONSTRUCTION, INC.

- A. AISC S303 - Code of Standard Practice for Steel Buildings and Bridges; 2010.

- 2.10 AISI -- AMERICAN IRON AND STEEL INSTITUTE
- 2.11 AMCA -- AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC.
- 2.12 ANSI -- AMERICAN NATIONAL STANDARDS INSTITUTE
- 2.13 API -- AMERICAN PETROLEUM INSTITUTE
- 2.14 ARI -- AIR-CONDITIONING AND REFRIGERATION INSTITUTE (SEE AHRI)
- 2.15 ASCE -- AMERICAN SOCIETY OF CIVIL ENGINEERS
- 2.16 ASHRAE -- AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC.
- 2.17 ASME -- THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
- 2.18 ASSE -- AMERICAN SOCIETY OF SANITARY ENGINEERING
- 2.19 ASTM A SERIES -- ASTM INTERNATIONAL
 - A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

- 2.20 AWCI -- ASSOCIATION OF THE WALL AND CEILING INDUSTRIES INTERNATIONAL
- 2.21 AWI -- ARCHITECTURAL WOODWORK INSTITUTE
- 2.22 AWPA -- AMERICAN WOOD-PRESERVERS' ASSOCIATION
- 2.23 AWS -- AMERICAN WELDING SOCIETY
- 2.24 AWWA -- AMERICAN WATER WORKS ASSOCIATION
- 2.25 BHMA -- BUILDERS HARDWARE MANUFACTURERS ASSOCIATION
- 2.26 BIA -- BRICK INDUSTRY ASSOCIATION
- 2.27 BOCA -- BUILDING OFFICIALS & CODE ADMINISTRATORS INTERNATIONAL, INC.
- 2.28 CISCA -- CEILINGS & INTERIOR SYSTEMS CONSTRUCTION ASSOCIATION
- 2.29 CISPI -- CAST IRON SOIL PIPE INSTITUTE
- 2.30 CPSC -- CONSUMER PRODUCTS SAFETY COMMISSION
- 2.31 CRSI -- CONCRETE REINFORCING STEEL INSTITUTE
- 2.32 CSA -- CSA INTERNATIONAL (FORMERLY CANADIAN STANDARDS ASSOCIATION)
- 2.33 CSI/CSC -- CONSTRUCTION SPECIFICATIONS INSTITUTE/CONSTRUCTION SPECIFICATIONS CANADA
- 2.34 CTI -- COOLING TECHNOLOGY INSTITUTE
- 2.35 DHI -- DOOR AND HARDWARE INSTITUTE
- 2.36 EIA -- ELECTRONIC INDUSTRIES ALLIANCE
- 2.37 EJCDC -- ENGINEERS' JOINT CONTRACT DOCUMENTS COMMITTEE
- 2.38 EJMA -- EXPANSION JOINT MANUFACTURERS ASSOCIATION
- 2.39 FM -- FACTORY MUTUAL GLOBAL
- 2.40 GA -- GYPSUM ASSOCIATION
- 2.41 GANA -- GLASS ASSOCIATION OF NORTH AMERICA
- 2.42 GRI -- GEOSYNTHETIC RESEARCH INSTITUTE
- 2.43 HI -- THE HYDRONICS INSTITUTE (SEE AHR)
- 2.44 HPW -- H.P. WHITE LABORATORY, INC.
- 2.45 IAPMO -- INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL

OFFICIALS

- 2.46 IAS -- INTERNATIONAL ACCREDITATION SERVICE
- 2.47 ICBO -- INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS
- 2.48 ICBO-ES -- ICBO EVALUATION SERVICE, INC.
- 2.49 ICC -- INTERNATIONAL CODE COUNCIL, INC.
- 2.50 ICC-ES -- ICC EVALUATION SERVICE, INC.
- 2.51 ICEA -- INSULATED CABLE ENGINEERS ASSOCIATION
- 2.52 IEEE -- INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS
- 2.53 IGMA -- INSULATING GLASS MANUFACTURERS ALLIANCE
- 2.54 ISSFA - INTERNATIONAL SOLID SURFACE FABRICATORS ASSOCIATION
- 2.55 ITS -- INTERTEK TESTING SERVICES NA, INC.
- 2.56 MFMA -- METAL FRAMING MANUFACTURERS ASSOCIATION
- 2.57 MPI -- MASTER PAINTERS INSTITUTE (MASTER PAINTERS AND DECORATORS ASSOCIATION)
- 2.58 MSS -- MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC.
- 2.59 NAAMM -- THE NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS
- 2.60 NACE -- NACE INTERNATIONAL
- 2.61 NADCA -- NATIONAL AIR DUCT CLEANING ASSOCIATION
- 2.62 NCMA -- NATIONAL CONCRETE MASONRY ASSOCIATION
- 2.63 NEBB -- NATIONAL ENVIRONMENTAL BALANCING BUREAU
- 2.64 NECA -- NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION
- 2.65 NEMA -- NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
- 2.66 NETA -- INTERNATIONAL ELECTRICAL TESTING ASSOCIATION
- 2.67 NFPA -- NATIONAL FIRE PROTECTION ASSOCIATION
- 2.68 NFRC -- NATIONAL FENESTRATION RATING COUNCIL, INC.
- 2.69 NRCA -- NATIONAL ROOFING CONTRACTORS ASSOCIATION

REFERENCE STANDARDS

- 2.70 PDCA -- PAINTING AND DECORATING CONTRACTORS OF AMERICA
 - 2.71 PDI -- PLUMBING AND DRAINAGE INSTITUTE
 - 2.72 RCSC -- RESEARCH COUNCIL ON STRUCTURAL CONNECTIONS
 - 2.73 SAE -- SAE INTERNATIONAL
 - 2.74 SBCCI -- SOUTHERN BUILDING CODE CONGRESS INTERNATIONAL, INC.
 - 2.75 SDI -- STEEL DECK INSTITUTE
 - 2.76 SIGMA -- SEALED INSULATING GLASS MANUFACTURERS ASSOCIATION (SEE IGMA)
 - 2.77 SMACNA -- SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC.
 - 2.78 SPRI -- SINGLE PLY ROOFING INDUSTRY
 - 2.79 SSPC -- SOCIETY FOR PROTECTIVE COATINGS
 - 2.80 SWRI -- SEALANT, WATERPROOFING AND RESTORATION INSTITUTE
 - 2.81 TIA -- TELECOMMUNICATIONS INDUSTRY ASSOCIATION
 - 2.82 UL -- UNDERWRITERS LABORATORIES INC.
 - 2.83 USGBC -- U. S. GREEN BUILDING COUNCIL
 - 2.84 WASTEC -- WASTE EQUIPMENT TECHNOLOGY ASSOCIATION
 - 2.85 WCLIB -- WEST COAST LUMBER INSPECTION BUREAU
 - 2.86 WI -- WOODWORK INSTITUTE
 - 2.87 WMMPA -- WOOD MOULDING AND MILLWORK PRODUCERS ASSOCIATION
- END OF SECTION**

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Temporary telecommunications services.
- B. Temporary sanitary facilities.
- C. Temporary Controls: Barriers, enclosures, and fencing.
- D. Security requirements.
- E. Vehicular access and parking.
- F. Waste removal facilities and services.
- G. Project identification sign.

1.02 RELATED REQUIREMENTS

- A. Section 01 51 00 - Temporary Utilities.
- B. Section 01 52 13 - Field Offices and Sheds.

1.03 TEMPORARY UTILITIES - SEE SECTION 01 51 00

- A. Provide and pay for all heating and cooling and ventilation required for construction purposes.
- B. Existing facilities may not be used.
- C. New permanent facilities may not be used.
- D. Use trigger-operated nozzles for water hoses, to avoid waste of water.

1.04 TELECOMMUNICATIONS SERVICES

- A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.
- B. Telecommunications services shall include:
 - 1. Windows-based personal computer dedicated to project telecommunications, with necessary software and laser printer.
 - 2. Telephone Land Lines: One line, minimum; one handset per line.
 - 3. Internet Connections: Minimum of one; DSL modem or faster.
 - 4. Email: Account/address reserved for project use.

1.05 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- B. Maintain daily in clean and sanitary condition.

1.06 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.

- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
- C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.07 FENCING

- A. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.08 EXTERIOR ENCLOSURES

- A. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.09 SECURITY - SEE SECTION 01 35 53

- A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

1.10 VEHICULAR ACCESS AND PARKING

- A. Coordinate access and haul routes with governing authorities and Owner.
- B. Provide and maintain access to fire hydrants, free of obstructions.
- C. Provide means of removing mud from vehicle wheels before entering streets.
- D. Designated existing on-site roads may be used for construction traffic.
- E. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.
- F. Existing parking areas located at north end of existing parking lot may be used for construction parking.

1.11 WASTE REMOVAL

- A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- B. Provide containers with lids. Remove trash from site periodically.
- C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
- D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.12 PROJECT IDENTIFICATION

- A. Provide project identification sign of design and construction indicated on Drawings.
- B. Erect on site at location indicated.
- C. No other signs are allowed without Owner permission except those required by law.

1.13 FIELD OFFICES - SEE SECTION 01 52 13

- A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack and drawing display table.
- B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.
- C. Locate offices a minimum distance of 30 feet from existing and new structures.

1.14 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.
- B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.
- D. Restore existing facilities used during construction to original condition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 51 00 - TEMPORARY UTILITIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Temporary Utilities: Electricity, lighting, heat, ventilation, and water.

1.02 TEMPORARY ELECTRICITY

- A. Cost: By Owner.
- B. Connect to Owner's existing power service.
 - 1. Do not disrupt Owner's need for continuous service.
 - 2. Exercise measures to conserve energy.
- C. Provide temporary electric feeder from existing building electrical service at location as directed.
- D. Complement existing power service capacity and characteristics as required.
- E. Provide power outlets for construction operations, with branch wiring and distribution boxes located at each floor. Provide flexible power cords as required.
- F. Provide main service disconnect and over-current protection at convenient location and meter.
- G. Permanent convenience receptacles may not be utilized during construction.
- H. Provide adequate distribution equipment, wiring, and outlets to provide single phase branch circuits for power and lighting.

1.03 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

- A. Provide and maintain incandescent lighting for construction operations to achieve a minimum lighting level of 2 watt/sq ft .
- B. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.
- C. Maintain lighting and provide routine repairs.

1.04 TEMPORARY HEATING

- A. Cost of Energy: By Contractor.
- B. Provide heating devices and heat as needed to maintain specified conditions for construction operations.
- C. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.
- D. Prior to operation of permanent equipment for temporary heating purposes, verify that installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.

1.05 TEMPORARY COOLING

- A. Cost of Energy: By Contractor.

- B. Provide cooling devices and cooling as needed to maintain specified conditions for construction operations.
- C. Maintain maximum ambient temperature of 80 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.
- D. Prior to operation of permanent equipment for temporary cooling purposes, verify that installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.

1.06 TEMPORARY WATER SERVICE

- A. Cost of Water Used: By Owner.
- B. Provide and maintain suitable quality water service for construction operations at time of project mobilization.
- C. Connect to existing water source.
 - 1. Exercise measures to conserve water.
- D. Extend branch piping with outlets located so water is available by hoses with threaded connections. Provide temporary pipe insulation to prevent freezing.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 52 13 - FIELD OFFICES AND SHEDS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Temporary field offices for use of Contractor.

1.02 RELATED REQUIREMENTS

- A. Section 01 50 00 - Temporary Facilities and Controls:

1.03 USE OF PERMANENT FACILITIES

- A. When permanent facilities are enclosed with operable utilities, relocate offices into building, with written agreement of Owner, and remove temporary buildings.

PART 2 PRODUCTS

2.01 MATERIALS, EQUIPMENT, FURNISHINGS

2.02 CONSTRUCTION

- A. Portable or mobile buildings, or buildings constructed with floors raised above ground, securely fixed to foundations, with steps and landings at entrance doors.
- B. Exterior Materials: Weather resistant, finished in one color.
- C. Interior Materials in Offices: Sheet type materials for walls and ceilings, prefinished or painted; resilient floors and bases.
- D. Fire Extinguishers: Appropriate type fire extinguisher at each office.

2.03 ENVIRONMENTAL CONTROL

- A. Heating, Cooling, and Ventilating: Automatic equipment to maintain comfort conditions.

2.04 CONTRACTOR OFFICE AND FACILITIES

- A. Size: For Contractor's needs and to provide space for project meetings.
- B. Telephone: As specified in Section 01 50 00.
- C. Other Furnishings: Contractor's option.

PART 3 EXECUTION

3.01 PREPARATION

- A. Fill and grade sites for temporary structures to provide drainage away from buildings.

3.02 INSTALLATION

- A. Install office spaces ready for occupancy 15 days after date fixed in Notice to Proceed.

3.03 REMOVAL

- A. At completion of Work remove buildings, foundations, utility services, and debris. Restore areas.

END OF SECTION

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General product requirements.
- B. Transportation, handling, storage and protection.
- C. Product option requirements.
- D. Substitution limitations and procedures.
- E. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.

1.03 SUBMITTALS

- A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
 - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by the Contract Documents.
- B. DO NOT USE products having any of the following characteristics:
 - 1. Made of wood from newly cut old growth timber.
 - 2. Containing lead, cadmium, asbestos.
- C. Where all other criteria are met, Contractor shall give preference to products that:
 - 1. If used on interior, have lower emissions, as defined in Section 01 61 16.
 - 2. If wet-applied, have lower VOC content, as defined in Section 01 61 16.
 - 3. Result in less construction waste.
 - 4. Have a published GreenScreen Chemical Hazard Analysis.

2.02 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.03 MAINTENANCE MATERIALS

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION PROCEDURES

- A. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.
- B. A request for substitution constitutes a representation that the submitter:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
 - 2. Agrees to provide the same warranty for the substitution as for the specified product.
 - 3. Agrees to coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension that may subsequently become apparent.

3.02 TRANSPORTATION AND HANDLING

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- D. Transport and handle products in accordance with manufacturer's instructions.
- E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.03 STORAGE AND PROTECTION

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.

- D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.
- G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- H. Comply with manufacturer's warranty conditions, if any.
- I. Do not store products directly on the ground.
- J. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- K. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- L. Prevent contact with material that may cause corrosion, discoloration, or staining.
- M. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- N. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.01 WASTE MANAGEMENT REQUIREMENTS

- A. Owner requires that this project generate the least amount of trash and waste possible.
- B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
- D. Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, incineration, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues; use the same units of measure on all reports.
- E. Methods of trash/waste disposal that are not acceptable are:
 - 1. Burning on the project site.
 - 2. Burying on the project site.
 - 3. Dumping or burying on other property, public or private.
 - 4. Other illegal dumping or burying.
- F. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.02 DEFINITIONS

- A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.
- B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.
- C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.
- D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.
- E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
- F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- I. Return: To give back reusable items or unused products to vendors for credit.
- J. Reuse: To reuse a construction waste material in some manner on the project site.

- K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
- M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- N. Toxic: Poisonous to humans either immediately or after a long period of exposure.
- O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
 - 1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
 - 2. Submit Report on a form acceptable to Owner.
 - 3. Landfill Disposal: Include the following information:
 - a. Identification of material.
 - b. Amount, in tons or cubic yards, of trash/waste material from the project disposed of in landfills.
 - c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - 4. Incinerator Disposal: Include the following information:
 - a. Identification of material.
 - b. Amount, in tons or cubic yards, of trash/waste material from the project delivered to incinerators.
 - c. State the identity of incinerators, total amount of fees paid to incinerator, and total disposal cost.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - 5. Recycled and Salvaged Materials: Include the following information for each:
 - a. Identification of material, including those retrieved by installer for use on other projects.
 - b. Amount, in tons or cubic yards, date removed from the project site, and receiving party.
 - c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
 - 6. Material Reused on Project: Include the following information for each:

- a. Identification of material and how it was used in the project.
 - b. Amount, in tons or cubic yards.
 - c. Include weight tickets as evidence of quantity.
7. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

PART 3 EXECUTION

2.01 WASTE MANAGEMENT PROCEDURES

- A. See Section 01 30 00 for additional requirements for project meetings, reports, submittal procedures, and project documentation.
- B. See Section 01 50 00 for additional requirements related to trash/waste collection and removal facilities and services.
- C. See Section 01 60 00 for waste prevention requirements related to delivery, storage, and handling.
- D. See Section 01 70 00 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

2.02 WASTE MANAGEMENT PLAN IMPLEMENTATION

- A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.
- B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.
- C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.
- D. Meetings: Discuss trash/waste management goals and issues at project meetings.
 - 1. Pre-bid meeting.
 - 2. Pre-construction meeting.
 - 3. Regular job-site meetings.
- E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
 - 1. Provide containers as required.
 - 2. Provide adequate space for pick-up and delivery and convenience to subcontractors.
 - 3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.
- F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.
- G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.
- H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.

I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION

SECTION 01 78 00 - CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Project Record Documents.
- B. Operation and Maintenance Data.
- C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

- A. Section 01 30 00 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- B. Individual Product Sections: Specific requirements for operation and maintenance data.
- C. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

- A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.
- B. Operation and Maintenance Data:
 - 1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
 - 2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
 - 3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
 - 4. Submit two sets of revised final documents in final form within 10 days after final inspection.
- C. Warranties and Bonds:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 - 2. Make other submittals within 10 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 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Addenda.

- 3. Change Orders and other modifications to the Contract.
- 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.
- E. Record Drawings : Legibly mark each item to record actual construction including:
 - 1. Field changes of dimension and detail.
 - 2. Details not on original Contract drawings.
 - 3. Provide electronic copy to architect and owner.

3.02 OPERATION AND MAINTENANCE DATA

- A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

- A. For Each Product, Applied Material, and Finish:
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- C. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. For Each Item of Equipment and Each System:
 - 1. Description of unit or system, and component parts.
 - 2. Identify function, normal operating characteristics, and limiting conditions.
 - 3. Include performance curves, with engineering data and tests.
 - 4. Complete nomenclature and model number of replaceable parts.
- B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- C. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- D. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

- E. Provide servicing and lubrication schedule, and list of lubricants required.
- F. Include manufacturer's printed operation and maintenance instructions.
- G. Include sequence of operation by controls manufacturer.
- H. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- I. Additional Requirements: As specified in individual product specification sections.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

- A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
- B. Where systems involve more than one specification section, provide separate tabbed divider for each system.
- C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
- F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
- G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
- I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

3.06 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.

END OF SECTION

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.01 SUMMARY

- A. Demonstration of products and systems to be commissioned and where indicated in specific specification sections.
- B. Training of Owner personnel in operation and maintenance is required for:
 - 1. All software-operated systems.
 - 2. HVAC systems and equipment.
 - 3. Plumbing equipment.
 - 4. Electrical systems and equipment.
 - 5. Conveying systems.
 - 6. Landscape irrigation.
- C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
 - 1. Roofing, waterproofing, and other weather-exposed or moisture protection products.
 - 2. Finishes, including flooring, wall finishes, ceiling finishes.
 - 3. Fixtures and fittings.
 - 4. Items specified in individual product Sections.

1.02 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures; except:
 - 1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority.
 - 2. Submit one copy to the Commissioning Authority, not to be returned.
 - 3. Make commissioning submittals on time schedule specified by Commissioning Authority.
 - 4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of overall Training Plan; submit in editable electronic format, Microsoft Word 2003 preferred.
- B. Draft Training Plans: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
 - 1. Submit to Commissioning Authority for review and inclusion in overall training plan.
 - 2. Submit not less than four weeks prior to start of training.
 - 3. Revise and resubmit until acceptable.
 - 4. Provide an overall schedule showing all training sessions.
 - 5. Include at least the following for each training session:
 - a. Identification, date, time, and duration.
 - b. Description of products and/or systems to be covered.
 - c. Name of firm and person conducting training; include qualifications.
 - d. Intended audience, such as job description.
 - e. Objectives of training and suggested methods of ensuring adequate training.
 - f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
 - g. Media to be used, such as slides, hand-outs, etc.
 - h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.
- C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.

1. Include applicable portion of O&M manuals.
2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
3. Provide one extra copy of each training manual to be included with operation and maintenance data.

1.03 QUALITY ASSURANCE

- A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
 1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
 2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 DEMONSTRATION - GENERAL

- A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.
- B. Demonstrations conducted during Functional Testing need not be repeated unless Owner personnel training is specified.
- C. Demonstration may be combined with Owner personnel training if applicable.
- D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
 1. Perform demonstrations not less than two weeks prior to Substantial Completion.
 2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- E. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
 1. Perform demonstrations not less than two weeks prior to Substantial Completion.

3.02 TRAINING - GENERAL

- A. Commissioning Authority will prepare the Training Plan based on draft plans submitted.
- B. Conduct training on-site unless otherwise indicated.
- C. Owner will provide classroom and seating at no cost to Contractor.
- D. Do not start training until Functional Testing is complete, unless otherwise specified or approved by the Commissioning Authority.
- E. Provide training in minimum two hour segments.
- F. The Commissioning Authority is responsible for determining that the training was satisfactorily completed and will provide approval forms.
- G. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to

conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.

- H. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
 - 1. The location of the O&M manuals and procedures for use and preservation; backup copies.
 - 2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
 - 3. Typical uses of the O&M manuals.
- I. Product- and System-Specific Training:
 - 1. Review the applicable O&M manuals.
 - 2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
 - 3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
 - 4. Provide hands-on training on all operational modes possible and preventive maintenance.
 - 5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
 - 6. Discuss common troubleshooting problems and solutions.
 - 7. Discuss any peculiarities of equipment installation or operation.
 - 8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
 - 9. Review recommended tools and spare parts inventory suggestions of manufacturers.
 - 10. Review spare parts and tools required to be furnished by Contractor.
 - 11. Review spare parts suppliers and sources and procurement procedures.
- J. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION

SECTION 02 41 00 - DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Building demolition .
- B. Selective demolition of built site elements.
- C. Abandonment and removal of existing utilities and utility structures.

1.02 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary: Limitations on Contractor's use of site and premises.
- B. Section 01 10 00 - Summary: Description of items to be salvaged or removed for re-use by Contractor.
- C. Section 01 50 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- D. Section 01 60 00 - Product Requirements: Handling and storage of items removed for salvage and relocation.
- E. Section 01 70 00 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.
- F. Section 01 74 19 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- G. Section 31 10 00 - Site Clearing: Vegetation and existing debris removal.
- H. Section 31 22 00 - Grading: Topsoil removal.
- I. Section 31 22 00 - Grading: Fill material for filling holes, pits, and excavations generated as a result of removal operations.
- J. Section 31 23 23 - Fill: Fill material for filling holes, pits, and excavations generated as a result of removal operations.
- K. Section 31 23 23 - Fill: Filling holes, pits, and excavations generated as a result of removal operations.

1.03 REFERENCE STANDARDS

- A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2013.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Site Plan: Showing:
 - 1. Areas for temporary construction and field offices.
 - 2. Areas for temporary and permanent placement of removed materials.
- C. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.

1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences.
 2. Identify demolition firm and submit qualifications.
 3. Include a summary of safety procedures.
- D. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.05 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: Company specializing in the type of work required.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Fill Material: As specified in Section 31 23 23 - Fill.

PART 3 EXECUTION

3.01 SCOPE

- A. Remove paving and curbs as required to accomplish new work.
- B. Remove all other paving and curbs within site boundaries.
- C. Remove concrete slabs on grade within site boundaries.
- D. Remove other items indicated, for salvage, relocation, and recycling.
- E. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as specified in Section 31 22 00.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
1. Obtain required permits.
 2. Comply with applicable requirements of NFPA 241.
 3. Use of explosives is not permitted.
 4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 5. Provide, erect, and maintain temporary barriers and security devices.
 6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
 7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 8. Do not close or obstruct roadways or sidewalks without permit.
 9. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
 10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from Owner.

- C. Do not begin removal until built elements to be salvaged or relocated have been removed.
- D. Do not begin removal until vegetation to be relocated has been removed and specified measures have been taken to protect vegetation to remain.
- E. Protect existing structures and other elements that are not to be removed.
 - 1. Provide bracing and shoring.
 - 2. Prevent movement or settlement of adjacent structures.
 - 3. Stop work immediately if adjacent structures appear to be in danger.
- F. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- G. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
- H. Hazardous Materials: Comply with 29 CFR 1926 and state and local regulations.
- I. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

3.03 EXISTING UTILITIES

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
- H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

3.04 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Remove from site all materials not to be reused on site; comply with requirements of Section 01 74 19 - Waste Management.
- C. Leave site in clean condition, ready for subsequent work.
- D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 03 05 05 - UNDERSLAB VAPOR BARRIER

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sheet vapor barrier under concrete slabs on grade.

1.02 RELATED REQUIREMENTS

- A. Section 03 10 00 - Concrete Forming and Accessories: Forms and accessories for formwork.
- B. Section 03 20 00 - Concrete Reinforcing.
- C. Section 03 30 00 - Cast-in-Place Concrete: Preparation of subgrade, granular fill, placement of concrete.

1.03 REFERENCE STANDARDS

- A. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2011.
- B. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2011.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products.
- C. Test Data: Submit report of tests showing compliance with specified requirements.
- D. Samples: Submit samples of underslab vapor barrier to be used.
- E. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Underslab Vapor Barrier:
 - 1. Water Vapor Permeance: Not more than 0.010 perms, maximum.
 - 2. Complying with ASTM E1745 Class A.
 - 3. Thickness: 15 mils.
 - 4. Basis of Design:
 - a. Stego Industries LLC; Stego Wrap Vapor Barrier (15-mil): www.stegoindustries.com.
 - b. Raven Industries, 800-635-3456.
 - c. W.R. Meadows, 800-342-5976.
- B. Accessory Products: Vapor barrier manufacturer's recommended tape, adhesive, mastic, etc., for sealing seams and penetrations in vapor barrier.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surface over which vapor barrier is to be installed is complete and ready before proceeding with installation of vapor barrier.

3.02 INSTALLATION

- A. Install vapor barrier in accordance with manufacturer's instructions and ASTM E1643.
- B. Install vapor barrier under interior slabs on grade; lap sheet over footings and seal to foundation walls.
- C. Lap joints minimum 6 inches.
- D. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions.
- E. No penetration of vapor barrier is allowed except for reinforcing steel and permanent utilities.
- F. Repair damaged vapor retarder before covering with other materials.

END OF SECTION

SECTION 03 20 00 - CONCRETE REINFORCING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Reinforcing steel for cast-in-place concrete.
- B. Supports and accessories for steel reinforcement.
- C. Reinforcing for concrete masonry.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 04 20 00 - Unit Masonry: Reinforcement for masonry.

1.03 REFERENCE STANDARDS

- A. ACI 301 - Specifications for Structural Concrete; 2010 (Errata 2012).
- B. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2011.
- C. ACI SP-66 - ACI Detailing Manual; 2004.
- D. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.
- E. ASTM A706/A706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement; 2014.
- F. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2015.
- G. AWS D1.4/D1.4M - Structural Welding Code - Reinforcing Steel; 2011.
- H. CRSI (DA4) - Manual of Standard Practice; 2009.
- I. CRSI (P1) - Placing Reinforcing Bars; 2011.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Comply with requirements of ACI SP-66. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.
 - 1. Prepare shop drawings under seal of a Professional Engineer experienced in design of work of this type and licensed in the State in which the Project is located.
- C. Manufacturer's Certificate: Certify that reinforcing steel and accessories and products supplied for this project meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with CRSI (DA4), ACI 301, ACI SP-66, ACI 318, and ASTM A184/A184M.
 - 1. Maintain one copy of each document on project site.
- B. Provide Architect with access to fabrication plant to facilitate inspection of reinforcement. Provide notification of commencement and duration of shop fabrication in sufficient time to allow inspection.

- C. Welders' Certificates: Submit certifications for welders employed on the project, verifying AWS qualification within the previous 12 months.

PART 2 PRODUCTS

2.01 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
 - 1. Deformed billet-steel bars.
 - 2. Unfinished.
- B. Reinforcing Steel: ASTM A706/A706M, deformed low-alloy steel bars.
 - 1. Unfinished.
- C. Steel Welded Wire Reinforcement (WWR): Plain type; ASTM A1064/A1064M.
 - 1. Form: Flat Sheets.
 - 2. Mesh Size and Wire Gage: As indicated on drawings.
- D. Reinforcement Accessories:
 - 1. Tie Wire: Annealed, minimum 16 gage, 0.0508 inch.
 - 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
 - 3. Provide plastic components for placement within concrete cover as defined on the drawings.

2.02 RE-BAR SPLICING:

- A. Coupler Systems: Mechanical devices for splicing reinforcing bars; capable of developing full steel reinforcing design strength in tension and compression.
 - 1. Products:
 - a. Dayton Superior Corporation; Bar Lock Coupler System: www.daytonsuperior.com.
- B. Dowel Bar Splicer with Dowel-Ins: Mechanical devices for connecting dowels; capable of developing full steel reinforcing design strength in tension and compression.
 - 1. Products:
 - a. Dayton Superior Corporation; Dowel Bar Splicer D101A with Straight Dowel-In: www.daytonsuperior.com.
- C. Grout: Cementitious, non-metallic, non-shrink grout for use with manufacturer's grout sleeve reinforcing bar coupler system.
 - 1. Products:
 - a. Dayton Superior Corporation; Sleeve-Lock Grout: www.daytonsuperior.com.

2.03 FABRICATION

- A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice, ACI SP-66 - ACI Detailing Manual, ACI 318, and ASTM A184/A184M.
- B. Welding of reinforcement is permitted only with the specific approval of Architect. Perform welding in accordance with AWS D1.4/D1.4M.
- C. Locate reinforcing splices not indicated on drawings at point of minimum stress.
 - 1. Review locations of splices with Architect.

PART 3 EXECUTION

3.01 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position.
- B. Do not displace or damage vapor barrier.
- C. Accommodate placement of formed openings.
- D. Maintain concrete cover around reinforcing per ACI 318 for the given exposure:
 - 1. Footings and Concrete Formed Against Earth: 3 inch (76mm).
 - 2. Slabs on Fill: 3 inch (76mm).
- E. Bond and ground all reinforcement to requirements of Section 26 05 26.

3.02 FIELD QUALITY CONTROL

- A. An independent testing agency, as specified in Section 01 40 00, will inspect installed reinforcement for conformance to contract documents before concrete placement.

END OF SECTION

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete formwork.
- B. Elevated concrete slabs on composite deck.
- C. Floors and slabs on grade.
- D. Concrete foundations.
- E. Joint devices associated with concrete work.
- F. Miscellaneous concrete elements, including equipment pads, light pole bases, flagpole bases, thrust blocks, and manholes.
- G. Concrete curing.
- H. Concrete Formwork.

1.02 RELATED REQUIREMENTS

- A. Section 03 20 00 - Concrete Reinforcing.
- B. Section 03 35 11 - Concrete Floor Finishes: Densifiers, hardeners, applied coatings, and polishing.
- C. Section 07 92 00 - Joint Sealants: Products and installation for sealants for saw cut joints and isolation joints in slabs.
- D. Section 07 90 05 - Joint Sealers: Sealants for saw cut joints and isolation joints in slabs.
- E. Section 07 90 05 - Joint Sealers: Sealants for saw cut joints and isolation joints in slabs.
- F. Section 32 13 13 - Concrete Paving: Sidewalks, curbs and gutters.

1.03 REFERENCE STANDARDS

- A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials; 2010.
- B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).
- C. ACI 301 - Specifications for Structural Concrete; 2010 (Errata 2012).
- D. ACI 302.1R - Guide for Concrete Floor and Slab Construction; 2004 (Errata 2007).
- E. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000.
- F. ACI 305R - Hot Weather Concreting; 2010.
- G. ACI 306R - Cold Weather Concreting; 2010.
- H. ACI 308R - Guide to Curing Concrete; 2001 (Reapproved 2008).
- I. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2011.
- J. ACI 347R - Guide to Formwork for Concrete; 2014.
- K. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2013.

- L. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2015a.
- M. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2015.
- N. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2013.
- O. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2012.
- P. ASTM C150/C150M - Standard Specification for Portland Cement; 2015.
- Q. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2007.
- R. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2014.
- S. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a.
- T. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2011.
- U. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2013.
- V. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2015.
- W. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2014.
- X. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2014.
- Y. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete; 2011.
- Z. ASTM D994/D994M - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type); 2011.
- AA. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2004 (Reapproved 2013).
- AB. ASTM D2103 - Standard Specification for Polyethylene Film and Sheeting; 2015.
- AC. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a (Reapproved 2013).
- AD. ASTM E1155 - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers; 1996 (Reapproved 2008).
- AE. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2011.
- AF. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2011.
- AG. ASTM E1993/E1993M - Standard Specification for Bituminous Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs; 1998 (Reapproved 2013).
- AH. COE CRD-C 48 - Method of Test for Water Permeability of Concrete; 1992.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
- C. Mix Design: Submit proposed concrete mix design for each concrete strength and location.
- D. Samples: Submit samples of underslab vapor retarder to be used.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301 and ACI 318.
- B. Follow recommendations of ACI 305R when concreting during hot weather.
- C. Follow recommendations of ACI 306R when concreting during cold weather.

PART 2 PRODUCTS

2.01 FORMWORK

- A. Formwork Design and Construction: Comply with guidelines of ACI 347R to provide formwork that will produce concrete complying with tolerances of ACI 117.
- B. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
 - 1. Form Facing for Exposed Finish Concrete: Steel.
 - 2. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings.
 - 3. Form Ties: Cone snap type that will leave no metal within 1-1/2 inches of concrete surface.

2.02 REINFORCEMENT

- A. Comply with requirements of Section 03 20 00.

2.03 CONCRETE MATERIALS

- A. Cement: ASTM C150, Type I, or Type I/II - Portland type, grey.
 - 1. Acquire all cement for entire project from same source.
- B. Fine and Coarse Aggregates: ASTM C 33.
 - 1. Acquire all aggregates for entire project from same source.
- C. Fly Ash: ASTM C618, Class C.
- D. Water: ASTM C94/C 94M and potable.

2.04 ADMIXTURES

- A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement. Do not use calcium chloride or admixtures which contain calcium chloride.
- B. Air Entrainment Admixture: ASTM C260/C260M.
- C. High Range Water Reducing and Retarding Admixture: ASTM C494/C494M Type G.
- D. High Range Water Reducing Admixture: ASTM C494/C494M Type F.

- E. Water Reducing and Accelerating Admixture: ASTM C494/C494M Type E.
- F. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.
 - 1. Provide pigmented type, with ASTM C979/C979M inorganic pigments.
- G. Accelerating Admixture: ASTM C494/C494M Type C.
- H. Retarding Admixture: ASTM C494/C494M Type B.
- I. Water Reducing Admixture: ASTM C494/C494M Type A.

2.05 ACCESSORY MATERIALS

- A. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
 - 1. ASTM C1107/C1107M; Grade A, B, or C.
 - 2. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.
 - 3. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.

2.06 BONDING AND JOINTING PRODUCTS

- A. Waterstops: Hydrophilic non-bentonite, modified chloroprene rubber.
 - 1. Configuration: As indicated on drawings.
 - 2. Size: As indicated on drawings.
 - 3. Location: As shown on drawings.
 - 4. Products:
 - a. Hydrotite by Sika Greenstreak Corporation.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Reglets: Formed steel sheet, galvanized, with temporary filler to prevent concrete intrusion during placement.
- C. Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.
 - 1. Material: ASTM D1751, cellulose fiber, cork or self expanding cork. (Type II).
- D. Slab Contraction Joint Device: Preformed linear strip intended for pressing into wet concrete to provide straight route for shrinkage cracking.
- E. Slab Construction Joint Devices: Combination keyed joint form and screed, galvanized steel, with minimum 1 inch diameter holes for conduit or rebars to pass through at 6 inches on center; ribbed steel stakes for setting.
- F. Sealant and Primer: As specified in Section 07 90 05.

2.07 CURING MATERIALS

- A. Evaporation Reducer: Liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement.
 - 1. Products:
 - a. Dayton Superior Corporation; AquaFilm Concentrate J74: www.daytonsuperior.com.
 - b. SpecChem, LLC; SpecFilm Concentrate or SpecFilm RTU: www.specchemllc.com.
 - c. W.R. Meadows, Inc; Evapre or Evapre-RTU: www.wrmeadows.com.

- B. Curing and Sealing Compound, Moisture Emission Reducing: Liquid, membrane-forming, clear sealer, for application to newly placed concrete; capable of providing adequate bond for flooring adhesives, initially and over the long term; with sufficient moisture vapor impermeability to prevent deterioration of flooring adhesives due to moisture emission.
 - 1. Use this product to cure and seal all slabs to receive adhesively applied flooring or roofing.
 - 2. Comply with ASTM C309 and ASTM C1315 Type I Class A.
 - 3. VOC Content: Less than 100 g/L.
 - 4. Solids Content: 25 percent, minimum.
 - 5. Products:
 - a. Floor Seal Technology, Inc; VaporSeal 309 System: www.floorseal.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Moisture-Retaining Sheet: ASTM C171.
 - 1. Polyethylene film, clear, minimum nominal thickness of 0.0040 inch.
 - 2. White-burlap-polyethylene sheet, weighing not less than 10 ounces per linear yard, 40 inches wide.
- D. Water: Potable, not detrimental to concrete.

2.08 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
- B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
 - 1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.
- C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.
- D. Normal Weight Concrete:
 - 1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: 3,000 pounds per square inch.
 - 2. Fly Ash Content: Maximum 20 percent of cementitious materials by weight. In no case shall the amount of fly ash per cubic yard of concrete exceed 100 lbs.
 - 3. Water-Cement Ratio: Maximum 45 percent by weight for [4000] psi ([27.6] MPa) concrete. Maximum 55 percent for non-air-entrained by weight for [3000] psi ([20.7] MPa) concrete. Maximum 50 percent for air-entrained by weight for [3000] psi ([20.7] MPa) concrete.
 - 4. Total Air Content: 4 to 7 percent, determined in accordance with ASTM C173/C173M for exterior concrete.
 - 5. Maximum Slump: 4 inches plus or minus 1 inch.
 - 6. Maximum Aggregate Size: 3/4 inch. Proportion aggregates to provide a minimum of 50 percent coarse aggregate to total aggregate ratio.

2.09 MIXING

- A. Transit Mixers: Comply with ASTM C94/C94M.
 - 1. The addition of water to a batch at the job site will only be allowed when the Owner, Architect, Structural engineer and the Contractor agree to the following defined criteria at

the preconstruction meeting. This criteria must be strictly met when water is added to a batch at the job site.

- a. Water shall only be allowed to be added to a batch at the site if the measured concrete slump is less than 3 inch (76.2 mm).
 - b. When allowed, water should only be added once to the batch on-site and the addition of the water must be completed within 15 minutes from the start of the water addition.
 - c. The on-site added water must be properly mixed to ensure that a homogenous mixture is attained.
 - d. The maximum amount of water which may be added to the batch on-site is 1 gallon (3.78 liters) of water per 1 cu. yd. (0.76 cu.m) of concrete.
 - e. After the on-site added water has been added to the batch and the batch has been properly mixed, the concrete shall have a measured slump within the defined slump range of 3 inches (76.2 mm) to 5 inches (127 mm).
 - f. Concrete shall be rejected if the slump, after the addition of on-site water, does not occur with the slump range of 3 inches (76.2 mm) to 5 inches (127 mm) or is deemed unacceptable for placement.
 - g. The field testing and inspection agency and/or the approved Representative of the Owner shall monitor the implementation of the slump measurements and the water addition procedures.
2. When air temperature is between 85 deg F (29 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1 1/2 hours to 75 minutes, and when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

- A. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.
- B. Verify that forms are clean and free of rust before applying release agent.
- C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
- D. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.
 1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.
- E. Where new concrete with integral waterproofing is to be bonded to previously placed concrete, prepare surfaces to be treated in accordance with waterproofing manufacturer's instructions. Saturate cold joint surface with clean water, and remove excess water before application of coat of waterproofing admixture slurry. Apply slurry coat uniformly with semi-stiff bristle brush at rate recommended by waterproofing manufacturer.
- F. In locations where new concrete is doweled to existing work, drill holes in existing concrete, install specified adhesive and insert steel dowels.

- G. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.
 - 1. Vapor Retarder Over Granular Fill: Install compactible granular fill before placing vapor retarder as shown on the drawings. Do not use sand.

3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

- A. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.
- B. Install welded wire reinforcement in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire.
- C. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.

3.04 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304R.
- B. Place concrete for floor slabs in accordance with ACI 302.1R.
- C. Notify Architect not less than 24 hours prior to commencement of placement operations.
- D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- E. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
- F. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.
- G. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

3.05 SLAB JOINTING

- A. Anchor joint fillers and devices to prevent movement during concrete placement.
- B. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
 - 1. Install wherever necessary to separate slab from other building members, including columns, walls, equipment foundations, footings, stairs, manholes, sumps, and drains.
- C. Load Transfer Construction and Contraction Joints: Install load transfer devices as indicated; saw cut joint at surface as indicated for contraction joints.
- D. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 2 hours after placing; use 3/16 inch thick blade and cut at least 1 inch deep but not less than one quarter (1/4) the depth of the slab.
- E. Contraction Joint Devices: Use preformed joint device, with top set flush with top of slab.

- F. Construction Joints: Where not otherwise indicated, use metal combination screed and key form, with removable top section for joint sealant.

3.06 CONCRETE FINISHING

- A. Repair surface defects, including tie holes, immediately after removing formwork.
- B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.
- C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:
 - 1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.
- D. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
 - 1. Surfaces to Receive Thick Floor Coverings: "Wood float" as described in ACI 302.1R; thick floor coverings include quarry tile, ceramic tile, and terrazzo with full bed setting system.
 - 2. Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in ACI 302.1R; thin floor coverings include carpeting, resilient flooring, seamless flooring, thin set quarry tile, and thin set ceramic tile.
 - 3. Decorative Exposed Surfaces: Trowel as described in ACI 302.1R; use steel-reinforced plastic trowel blades instead of steel blades to avoid black-burnish marks; decorative exposed surfaces include surfaces to be stained or dyed, pigmented concrete, surfaces to receive liquid hardeners, surfaces to receive dry-shake hardeners, surfaces to be polished, and all other exposed slab surfaces.
 - a. Steel-Reinforced Plastic Trowel Blade Manufacturer: Wagman Metal Products, Inc: www.wagmanmetal.com.
 - 4. Other Surfaces to Be Left Exposed: Trowel as described in ACI 302.1R, minimizing burnish marks and other appearance defects.
 - a. Chemical Hardener: See Section 03 35 11.
- E. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1:100 nominal.

3.07 CURING AND PROTECTION

- A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
 - 1. Normal concrete: Not less than 7 days.
 - 2. High early strength concrete: Not less than 4 days.
- C. Formed Surfaces: Cure by moist curing with forms in place for full curing period.
- D. Surfaces Not in Contact with Forms:
 - 1. Slabs and Floors To Receive Adhesive-Applied Flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, either obtain the approval of the flooring and adhesive manufacturers prior to use or remove the surface coating after curing to flooring manufacturer's satisfaction.

2. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by saturated burlap or moisture-retaining cover..
 - a. Saturated Burlap: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place.
3. Final Curing: Begin after initial curing but before surface is dry.
 - a. Moisture-Retaining Sheet: Lap strips not less than 3 inches and seal with waterproof tape or adhesive; secure at edges.
 - b. Curing Compound: Apply in two coats at right angles, using application rate recommended by manufacturer.

3.08 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
- B. Provide free access to concrete operations at project site and cooperate with appointed firm.
- C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
- D. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.
- E. Compressive Strength Tests: ASTM C39/C39M. For each test, mold and cure three concrete test cylinders. Obtain test samples for every 75 cu yd or less of each class of concrete placed.
- F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
- G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.09 DEFECTIVE CONCRETE

- A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.
- B. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
- D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

3.10 PROTECTION

- A. Do not permit traffic over unprotected concrete floor surface until fully cured.

END OF SECTION

SECTION 04 20 00 - UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete Masonry Units (CMU's)
- B. Common Brick.
- C. Mortar and Grout.
- D. Reinforcement and Anchorage.
- E. Flashings.
- F. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 03 20 00 - Concrete Reinforcing: Reinforcing steel for grouted masonry.
- B. Section 05 50 00 - Metal Fabrications: Loose steel lintels.
- C. Section 06 10 00 - Rough Carpentry: Nailing strips built into masonry.
- D. Section 07 21 00 - Thermal Insulation: Insulation for cavity spaces.
- E. Section 07 62 00 - Sheet Metal Flashing and Trim: Through-wall masonry flashings.
- F. Section 07 84 00 - Firestopping: Firestopping at penetrations of fire-rated masonry and at top of fire-rated walls.
- G. Section 07 92 00 - Joint Sealants: Sealing control and expansion joints.
- H. Section 07 90 05 - Joint Sealers: Backing rod and sealant at control and expansion joints.

1.03 REFERENCE STANDARDS

- A. ACI 530/530.1/ERTA - Building Code Requirements and Specification for Masonry Structures and Related Commentaries; 2011.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.
- D. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2015.
- E. ASTM C55 - Standard Specification for Concrete Building Brick; 2011.
- F. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale); 2013.
- G. ASTM C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile; 2014.
- H. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2014.
- I. ASTM C140/C140M - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units; 2014.
- J. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2011.

- K. ASTM C150/C150M - Standard Specification for Portland Cement; 2015.
- L. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2006 (Reapproved 2011).
- M. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale); 2014.
- N. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2014a.
- O. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2011.
- P. ASTM C476 - Standard Specification for Grout for Masonry; 2010.
- Q. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2012.
- R. ASTM D4637/D4637M - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane; 2013.
- S. BIA Technical Notes No. 7 - Water Penetration Resistance - Design and Detailing; 2005.
- T. BIA Technical Notes No. 28B - Brick Veneer/Steel Stud Walls; 2005.
- U. BIA Technical Notes No. 46 - Maintenance of Brick Masonry; 2005.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories. Include design mix for each type of mortar and grout.
- C. Shop Drawings: Indicate bar sizes, spacings, reinforcement quantities, bending and cutting schedules, reinforcement supporting and spacing devices, and accessories.
- D. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
- E. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.
- F. Test Reports: Concrete masonry manufacturer's test reports for units with integral water repellent admixture.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

- A. Comply with provisions of ACI 530/530.1/ERTA, except where exceeded by requirements of the contract documents.
 - 1. Maintain one copy of each document on project site.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

1.08 FIELD CONDITIONS

- A. Cold and Hot Weather Requirements: Comply with requirements of ACI 530/530.1/ERTA or applicable building code, whichever is more stringent.
- B. Maintain materials and surrounding air temperature to minimum 40 degrees F (5 degrees C) prior to, during, and 48 hours after completion of masonry work.
- C. Maintain materials and surrounding air temperature to maximum 90 degrees F (32 degrees C) prior to, during, and 48 hours after completion of masonry work.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and as follows:
 - 1. Size: Standard units with nominal face dimensions of 16 x 8 inches and nominal depth of 8 inches and 12 inches or as indicated on drawings.
 - 2. Special Shapes: Provide non-standard blocks configured for corners, lintels, headers, control joint edges, and other detailed conditions.
 - 3. Load-Bearing Units: ASTM C90, lightweight.
 - a. Hollow block, as indicated.

2.02 BRICK UNITS

- A. Manufacturers:
 - 1. Kansas Brick and Tile: No other substitutions allowed.
- B. **Facing Brick Type 1 (Exterior):** ASTM C216, Type FBS, Grade SW.
 - 1. Color and texture: To Match Existing Building.
 - a. 75% - 25% Blend. 75% = 230 Dark Modular, 25% = 200 Harvard Modular.
 - 2. Nominal size: Modular.
 - 3. Special shapes: Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
 - 4. Provide special brick shapes matching profiles indicated on drawings.
 - 5. Compressive strength: as required, measured in accordance with ASTM C67.
- C. **Facing Brick Type 2 (Interior):** ASTM C216, Type FBS, Grade SW.
 - 1. Color and texture: To Match Existing Building.
 - a. 520 Dark Modular
 - 2. Nominal size: Modular.
 - 3. Special shapes: Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
 - 4. Provide special brick shapes matching profiles indicated on drawings.
 - 5. Compressive strength: as required, measured in accordance with ASTM C67.

2.03 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Mortar Aggregate: ASTM C144.
- D. Grout Aggregate: ASTM C404.
- E. Water: Clean and potable.
- F. Accelerating Admixture: For use in cold weather. Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C and recommended by manufacturer for use in masonry mortar of composition indicated.
 - 1. Acceptable Product: Subject to compliance with requirements, provide one of the following.
 - a. Euclid Chemical Company (The): Accelguard 80

2.04 REINFORCEMENT AND ANCHORAGE

- A. Manufacturers of Joint Reinforcement and Anchors:
 - 1. Blok-Lok Limited; _____: www.blok-lok.com.
 - 2. Hohmann & Barnard, Inc; 2-Seal Tie: www.h-b.com.
 - 3. WIRE-BOND: www.wirebond.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Reinforcing Steel: Type specified in Section 03 20 00; size as indicated on drawings; uncoated finish.
- C. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.
- D. Adjustable Multiple Wythe Joint Reinforcement: Truss type with adjustable ties or tabs spaced at 16 in on center and fabricated with moisture drip; ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/153M, Class B; 0.1483 inch side rods with 0.1483 inch cross rods and adjustable components of 0.1483 inch wire; width of components as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from each masonry face.
 - 1. Vertical adjustment: Not less than 2 inches.
 - 2. Seismic Feature: Provide lip, hook, or clip on extended leg of wall ties to engage or enclose not less than one continuous horizontal joint reinforcement wire of 0.1483 inch diameter.
 - 3. Insulation Clips: Provide clips at tabs or ties designed to secure insulation against outer face of inner wythe of masonry.
- E. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from masonry face.
 - 1. Concrete frame: Dovetail anchors of bent steel strap, nominal 1 inch width x 0.024 in thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.
 - 2. Steel frame: Crimped wire anchors for welding to frame, 0.25 inch thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.

- F. Two-Piece Wall Ties: Formed steel wire, 0.1875 inch thick, adjustable, eye and pintle type, hot dip galvanized to ASTM A 153/A 153M, Class B, sized to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from masonry face and to allow vertical adjustment of up to 1-1/4 in.
- G. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
 - 1. Anchor plates: Not less than 0.105 inch thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
 - 2. Wire ties: Manufacturer's standard shape, 0.1875 inch thick.
 - 3. Vertical adjustment: Not less than 3-1/2 inches.
- H. Metal-to-Metal Fasteners: Self-drilling, self-tapping screws; corrosion resistant finish or hot dip galvanized to ASTM A153/A153M.
 - 1. Manufacturers:
 - a. ITW Commercial Construction North America; Teks Select Series; _____ : www.ITWBuildex.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.05 FLASHINGS

- A. Flexible Flashing with Elvaloy KEE: Solid-phase plasticizer and flexibilizer added to membrane flashing.
 - 1. Manufacturers:
 - a. Hohmann & Barnard, Inc; _____ : www.h-b.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- B. EPDM Flashing: ASTM D4637, Type I, 0.040 inch thick.
 - 1. Manufacturers:
 - a. Hohmann & Barnard, Inc; _____ : www.h-b.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Rubberized Asphalt Flashing: Self-adhering polymer modified asphalt sheet; 40 mils (0.040 inch) minimum total thickness; with cross laminated polyethylene top and bottom surfaces.
 - 1. Manufacturers:
 - a. Advanced Building Products, Inc.; Strip-N-Flash: www.advancedbuildingproducts.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.06 ACCESSORIES

- A. Preformed Control Joints: Neoprene material. Provide with corner and tee accessories, fused joints.
 - 1. Manufacturers:
 - a. Blok-Lok Limited; _____ : www.blok-lok.com.
 - b. Hohmann & Barnard, Inc; _____ : www.h-b.com.
 - c. WIRE-BOND: www.wirebond.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self expanding; _____ inch wide by maximum lengths available.
 - 1. Manufacturers:

- a. Hohmann & Barnard, Inc; _____: www.h-b.com.
 - b. WIRE-BOND: www.wirebond.com.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Building Paper: ASTM D226/D226M, Type I ("No.15") asphalt felt.
- D. Nailing Strips: Softwood lumber, preservative treated; as specified in Section 06 10 00.
- E. Termination Bars: Stainless steel; compatible with membrane and adhesives.
- F. Type: Polyester mesh.
- 1. Manufacturers:
 - a. Blok-Lok Limited; _____: www.blok-lok.com.
 - b. CavClear/Archovations, Inc: www.cavclear.com.
 - c. Hohmann & Barnard, Inc; _____: www.h-b.com.
 - d. WIRE-BOND; _____: www.wirebond.com.
 - e. Mortar Net Solutions; _____: www.mortarnet.com.
 - f. Mortar Net Solutions; Mortar Net CellVent: www.mortarnet.com.
- G. Cavity Drainage Fabric: Full wall drainage and ventilation mat, Polyester or polypropylene mesh.
- 1. Manufacturers:
 - a. Mortar Net Solutions; _____: www.mortarnet.com.
 - b. CAV-AIR-ATOR 075 by Keene Building Envelope Products (1/2" thickness) (sheet size to match brick or Dur-o-wall spacing).
- H. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.07 LINTELS

2.08 MORTAR AND GROUT MIXES

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
- 1. Exterior, loadbearing masonry: Type S.
 - 2. Exterior, non-loadbearing masonry: Type S.
 - 3. Interior, loadbearing masonry: Type S.
 - 4. Interior, non-loadbearing masonry: Type N..
- B. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
- C. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.
- D. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COLD AND HOT WEATHER REQUIREMENTS

- A. Comply with requirements of ACI 530/530.1/ERTA or applicable building code, whichever is more stringent.
- B. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.
- C. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.

3.04 COURSING

- 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. Concrete Masonry Units:
 - 1. Bond: Running;
 - 2. Coursing: One unit and one mortar joint to equal 8 inches.
 - 3. Mortar Joints: Concave.
- D. Brick Units:
 - 1. Bond: Running.
 - 2. Coursing: Three units and three mortar joints to equal 8 inches.
 - 3. Mortar Joints: Concave.

3.05 PLACING AND BONDING

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- D. Remove excess mortar and mortar smears as work progresses.
- E. Interlock intersections and external corners, except for units laid in stack bond.
- F. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- G. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.
- H. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
- I. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.06 WEEPS/CAVITY VENTS

- A. Install weeps in veneer and cavity walls at 24 inches on center horizontally above through-wall flashing, above shelf angles and lintels, and at bottom of walls.
- B. Install cavity vents in veneer and cavity walls at 32 inches on center horizontally below shelf angles and lintels and near top of walls.

3.07 CAVITY MORTAR CONTROL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
- B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.
- C. Install cavity mortar control panels continuously throughout full height of exterior masonry cavities during construction of exterior wythe, complying with manufacturer's installation instructions. Verify that airspace width is no more than 3/8 inch greater than panel thickness. Install horizontally between joint reinforcement. Stagger end joints in adjacent rows. Fit to perimeter construction and penetrations without voids.
- D. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.08 REINFORCEMENT AND ANCHORAGE - GENERAL

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.
- E. Reinforce stack bonded unit joint corners and intersections with strap anchors 16 inches on center.
- F. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 32 inches horizontally and 16 inches vertically.
- G. Reinforcement Bars: Secure at locations indicated and to avoid displacement during grouting. Minimum spacing between bars or to masonry surfaces shall be one bar diameter.
 - 1. Welding of splices is not permitted.
- H. Reinforced Hollow Unit Masonry: Keep vertical cores to be grouted clear of mortar, including bed area of first course.
 - 1. Bond Beams: At bond beams or other locations for horizontally reinforced masonry, provide special masonry units or saw to accommodate reinforcement.
 - 2. Provide U-shaped block at bottom course of masonry lintels.

3.09 REINFORCEMENT AND ANCHORAGE - SINGLE WYTHER MASONRY

- A. Install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.

- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.

3.10 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

- A. Install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.
- E. Masonry Back-Up: Embed anchors to bond veneer at maximum 16 inches on center vertically and 32 inches (800mm) on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.

3.11 REINFORCEMENT AND ANCHORAGES - CAVITY WALL MASONRY

- A. Install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of openings.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.
- E. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Space anchors at maximum of 32 inches (800mm) horizontally and 16 inches (400 mm) vertically.
- F. Reinforce stack bonded unit joint corners and intersections with strap anchors 16 inches on center.

3.12 MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
 - 1. Extend flashings full width at such interruptions and at least 6 inches into adjacent masonry or turn up at least 8 inches to form watertight pan at non-masonry construction.
 - 2. Remove or cover protrusions or sharp edges that could puncture flashings.
 - 3. Seal lapped ends and penetrations of flashing before covering with mortar.
- B. Extend metal flashings through exterior face of masonry and turn down to form drip. Install joint sealer below drip edge to prevent moisture migration under flashing.
- C. Extend plastic, laminated, EPDM, and _____ flashings to within 1/4 inch of exterior face of masonry.
- D. Lap end joints of flashings at least 6 inches and seal watertight with flashing sealant/adhesive.

3.13 LINTELS

- A. Install loose steel lintels over openings as indicated on drawings.
- B. Install reinforced unit masonry lintels over openings where steel lintels are not scheduled.
 - 1. Reinforce openings as detailed on drawings.
 - 2. Do not splice reinforcing bars.

3. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
 4. Place and consolidate grout fill without displacing reinforcing.
 5. Allow masonry lintels to attain specified strength before removing temporary supports.
- C. Maintain minimum 16 inch (400 mm) bearing on each side of opening.

3.14 GROUTING AND GROUTED COMPONENTS

- A. Reinforce masonry wall components as defined on the drawings.
- B. Perform all grouting by means of low-lift technique. Do not employ high lift grouting.
- C. Low-Lift Grouting:
1. Limit height of grout lifts to 24" (600 mm) and the total grout pour heights to 48 inches (1,200 mm).
 2. Limit height of masonry to 16" (400 mm) above each pour.
 3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.
 4. Place grout for each pour continuously and consolidate each grout lift immediately; do not interrupt pours for more than 1-1/2 hours.
- D. Lap splices minimum 48 bar diameters.
- E. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- F. Place and consolidate grout fill without displacing reinforcing.

3.15 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
- C. Size control joint in accordance with Section 07 90 05 for sealant performance.

3.16 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.
- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
1. Fill adjacent masonry cores with grout minimum 16 inches (4 mm) from framed openings.
- D. Do not build into masonry construction organic materials that are subject to deterioration.

3.17 TOLERANCES

- A. Maximum Variation from Alignment of Columns: 1/4 inch.
- B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- D. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.

- E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
- F. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.
- G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.18 CUTTING AND FITTING

- A. Cut and fit for chases. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.19 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
- B. Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C140/C140M for conformance to requirements of this specification.
- C. Mortar Tests: Test each type of mortar in accordance with ASTM C780, testing with same frequency as masonry samples.

3.20 CLEANING

- A. Remove excess mortar and mortar droppings.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.
- D. Use non-metallic tools in cleaning operations.

3.21 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Structural steel framing members and support members.
- B. Base plates, shear stud connectors and expansion joint plates.
- C. Grouting under base plates.

1.02 RELATED REQUIREMENTS

- A. Section 05 21 00 - Steel Joist Framing.
- B. Section 05 31 00 - Steel Decking: Support framing for small openings in deck.
- C. Section 05 50 00 - Metal Fabrications: Steel fabrications affecting structural steel work.

1.03 REFERENCE STANDARDS

- A. AISC (MAN) - Steel Construction Manual; 2011.
- B. AISC S303 - Code of Standard Practice for Steel Buildings and Bridges; 2010.
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- E. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished; 2013.
- F. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- G. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- H. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014.
- I. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2014.
- J. ASTM A449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use; 2010.
- K. ASTM A490 - Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength; 2014a.
- L. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.
- M. ASTM A514/A514M - Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding; 2014.
- N. ASTM A529/A529M - Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality; 2014.
- O. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts; 2007a (Reapproved 2014).

- P. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2011 (Reapproved 2015).
- Q. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2015.
- R. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2014.
- S. ASTM E94 - Standard Guide for Radiographic Examination; 2004 (Reapproved 2010).
- T. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments; 2013.
- U. ASTM E165/E165M - Standard Test Method for Liquid Penetrant Examination for General Industry; 2012.
- V. ASTM E709 - Standard Guide for Magnetic Particle Testing; 2014.
- W. ASTM F436 - Standard Specification for Hardened Steel Washers; 2011.
- X. ASTM F959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners; 2013.
- Y. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2007a.
- Z. ASTM F1852 - Standard Specification for "Twist Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2011.
- AA. ASTM F2280 - Standard Specification for 93Twist Off94 Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 150 ksi Minimum Tensile Strength; 2012.
- AB. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
- AC. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.
- AD. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; International Accreditation Service, Inc; 2011.
- AE. ITS (DIR) - Directory of Listed Products; current edition.
- AF. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections; 2009.
- AG. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).
- AH. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).
- AI. UL (FRD) - Fire Resistance Directory; current edition.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
 2. Connections.
 3. Indicate cambers and loads.

- 4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.
- D. Fabricator Test Reports: Comply with ASTM A1011/A1011M.
- E. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.
- F. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.05 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with AISC "Steel Construction Manual."
- B. Comply with Section 10 of AISC "Code of Standard Practice for Steel Buildings and Bridges" for architecturally exposed structural steel.
- C. Maintain one copy of each document on site.
- D. Fabricator: Company specializing in performing the work of this section with minimum Five years of documented experience.
- E. Erector: Company specializing in performing the work of this section with minimum Five years of documented experience.
- F. Design connections not detailed on the drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Steel Angles and Plates: ASTM A36/A36M.
- B. Steel W Shapes and Tees: ASTM A992/A992M.
- C. Rolled Steel Structural Shapes: ASTM A992/A992M.
- D. Cold-Formed Structural Tubing: ASTM A500/A500M, Grade B.
- E. Pipe: ASTM A53/A53M, Grade B, Finish black and galvanized, as indicated.
- F. Shear Stud Connectors: Made from ASTM A108 Grade 1015 bars and A145 D1.1, Type B.
- G. High-Strength Structural Bolts, Nuts, and Washers: ASTM A325 or ASTM A325M, Type 1, medium carbon, galvanized, with matching compatible ASTM A563 or ASTM A563M nuts and ASTM F436 washers.
- H. High-Strength Structural Bolts: ASTM A490 or ASTM A490M; Type 1 alloy steel, with matching compatible ASTM A563 or ASTM A563M nuts and ASTM F436 washers.
- I. Tension Control Bolts: Twist-off type; ASTM F1852 or ASTM F2280.
- J. Unheaded Anchor Rods: ASTM F1554, Grade 36, plain, with matching ASTM A563 or ASTM A563M nuts and ASTM F436 Type 1 washers.
- K. Load Indicator Washers: Provide washers complying with ASTM F959 at connections requiring high-strength bolts.
- L. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

- M. Grout: Non-shrink, non-metallic aggregate type, complying with ASTM C1107/C1107M and capable of developing a minimum compressive strength of 7,000 psi at 28 days. Non-corrosive, non-staining grout.
- N. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.
- O. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

- A. Shop fabricate to greatest extent possible.
- B. Space shear stud connectors as indicated on the drawings.
- C. Continuously seal joined members by intermittent welds and plastic filler. Grind exposed welds smooth.
- D. Fabricate connections for bolt, nut, and washer connectors.

2.03 FINISH

- A. Prepare structural component surfaces in accordance with SSPC SP 3.
- B. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted.
- C. Galvanize structural steel members to comply with ASTM A123/A123M. Provide minimum 1.7 oz/sq ft galvanized coating.

2.04 SOURCE QUALITY CONTROL

- A. Provide shop testing and analysis of structural steel.
- B. High-Strength Bolts: Provide testing and verification of shop-bolted connections in accordance with RCSC "Specification for Structural Joints Using High-Strength Bolts", testing at least 25 percent of bolts at each connection.
- C. Welded Connections: Visually inspect all shop-welded connections. Test any suspect welds using one of the following:
 - 1. Radiographic testing performed in accordance with ASTM E94.
 - 2. Ultrasonic testing performed in accordance with ASTM E164.
 - 3. Liquid penetrant inspection performed in accordance with ASTM E165/E165M.
 - 4. Magnetic particle inspection performed in accordance with ASTM E709.
- D. Test all complete-joint-penetration welds by ultrasonic testing performed in accordance with ASTM E164.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.02 ERECTION

- A. Erect structural steel in compliance with AISC "Code of Standard Practice for Steel Buildings and Bridges".
- B. Allow for erection loads, and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- C. Field weld components indicated on shop drawings.
- D. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with RCSC "Specification for Structural Joints Using High-Strength Bolts".
- E. Do not field cut or alter structural members without approval of Architect.
- F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.
- G. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for nonshrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

3.03 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.

3.04 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
- B. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with RCSC "Specification for Structural Joints Using High-Strength Bolts", testing at least 25 percent of bolts at each connection.
- C. Welded Connections: Visually inspect all field-welded connections. Test any suspect welds using one of the following:
 - 1. Radiographic testing performed in accordance with ASTM E94.
 - 2. Ultrasonic testing performed in accordance with ASTM E164.
 - 3. Liquid penetrant inspection performed in accordance with ASTM E165/E165M.
 - 4. Magnetic particle inspection performed in accordance with ASTM E709.
- D. Test all complete-joint-penetration welds by Ultrasonic testing performed in accordance with ASTM E164.

END OF SECTION

SECTION 05 31 00 - STEEL DECKING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Roof deck.
- B. Composite floor deck.
- C. Bearing plates and angles.

1.02 RELATED REQUIREMENTS

- A. Section 03 20 00 - Concrete Reinforcing.
- B. Section 03 30 00 - Cast-in-Place Concrete: Concrete topping over metal deck.
- C. Section 04 20 00 - Unit Masonry: Placement of anchors for bearing plates embedded in unit masonry assemblies.
- D. Section 04 27 23 - Cavity Wall Unit Masonry: Placement of anchors for bearing plates embedded in cavity wall masonry.
- E. Section 05 12 00 - STRUCTURAL STEEL FRAMING: Placement of embedded steel anchors for bearing plates in cast-in-place concrete.
- F. Section 05 50 00 - Metal Fabrications: Steel angle concrete stops at deck edges.

1.03 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- B. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished; 2013.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- D. ASTM A510/A510M - Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel; 2013.
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2015.
- G. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2013.
- H. ASTM E384 - Standard Test Method for Microindentation Hardness of Materials; 2016.
- I. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.
- J. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2008.
- K. FM DS 1-28 - Wind Design; 2007.
- L. FM DS 1-29 - Roof Deck Securement and Above-Deck Roof Components; Factory Mutual System; 2006.
- M. FM (AG) - FM Approval Guide; Factory Mutual Research Corporation; current edition.

- N. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; International Accreditation Service, Inc; 2011.
- O. ICC-ES AC43 - Acceptance Criteria for Steel Deck Roof and Floor Systems; ICC Evaluation Service, Inc; 2010 (R2013).
- P. ICC-ES AC70 - Acceptance Criteria for Fasteners Power Driven into Concrete, Steel and Masonry Elements; ICC Evaluation Service, Inc; 2013.
- Q. ITS (DIR) - Directory of Listed Products; current edition.
- R. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- S. SDI (DM) - Publication No.30, Design Manual for Composite Decks, Form Decks, and Roof Decks; 2007.
- T. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).
- U. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).
- V. UL 209 - Cellular Metal Floor Raceways and Fittings; Current Edition, Including All Revisions.
- W. UL (FRD) - Fire Resistance Directory; current edition.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittals procedures.
- B. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.
 - 1. Indicate sheet lengths and quantities.
 - 2. Indicate anchorage of each deck type for each location. Fastener type and spacing as indicated on drawings.
- C. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.
- D. Certificates: Certify that products furnished meet or exceed specified requirements.
- E. Submit manufacturer's installation instructions.
- F. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.
- G. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel (AC172).
- B. Installer Qualifications: Company specializing in performing the work of this Section with minimum 5 years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Cut plastic wrap to encourage ventilation.

- B. Store deck on dry wood sleepers; slope for positive drainage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Steel Deck:
 - 1. Canam Steel Corporation; ____: www.canam-steeljoists.ws.
 - 2. Nucor-Vulcraft Group; ____: www.vulcraft.com.

2.02 STEEL DECK

- A. Roof Deck: Non-composite type, fluted steel sheet:
 - 1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230, with G90/Z275 galvanized coating.
 - 2. Structural Properties:
 - a. Section modulus: Deck type or profile as defined on the drawings.
 - b. Span Design: Multiple.
 - 3. Nominal Height: 3 inch.
 - 4. Profile: Fluted; SDI Deep Rib.
 - 5. Formed Sheet Width: 24 inch.
 - 6. Side Joints: Lapped, mechanically fastened.
 - 7. End Joints: Lapped, mechanically fastened.
 - 8. Fire Resistance Classification: Comply with UL (FRD) Assembly Number ____.
- B. Composite Floor Deck: Fluted steel sheet embossed to interlock with concrete:
 - 1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230, with G90/Z275 galvanized coating.
 - 2. Structural Properties:
 - a. Deck type or profile: As defined on the drawings.
 - 3. Span Design: Multiple.
 - 4. Minimum Metal Thickness, Excluding Finish: As defined on the drawings.
 - 5. Nominal Height: 1-1/2 inches.
 - 6. Profile: Fluted, as defined on the drawings..
 - 7. Formed Sheet Width: 36 inch.
 - 8. Side Joints: Lapped, mechanically fastened.
 - 9. End Joints: Lapped, mechanically fastened.
 - 10. Fire Resistance Classification: Comply with UL (FRD) Assembly Number ____.

2.03 ACCESSORY MATERIALS

- A. Bearing Plates and Angles: ASTM A36/A36M steel, unfinished.
- B. Welding Materials: AWS D1.1/D1.1M.
- C. Fasteners: Galvanized hardened steel, self tapping.
- D. Mechanical Fasteners: Steel; hex washer head, self-drilling, self-tapping.
 - 1. Design Requirements for Sidelap Connections: Provide number and type of fasteners that comply with the applicable requirements of SDI design method for roof deck and floor deck applications and ICC-ES AC43 and as indicated on drawings.
 - 2. Fasteners for Steel Roof Decks Protected with Waterproofing Membrane: ASTM B 633, SC1, Type III zinc electroplate.

- E. Weld Washers: Mild steel, uncoated, 3/4 inch outside diameter, 1/8 inch thick.
- F. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.
- G. Flute Closures: Closed cell foam rubber, 1 inch thick; profiled to fit tight to the deck.

2.04 FABRICATED DECK ACCESSORIES

- A. Sheet Metal Deck Accessories: Metal closure strips, wet concrete stops, and cover plates, 22 gage, 0.0299 inch thick sheet steel; of profile and size as indicated; finished same as deck.
- B. Roof Sump Pans: Formed sheet steel, 14 gage, 0.0747 inch minimum thickness, flat bottom, sloped sides, recessed 1-1/2 inches below roof deck surface, bearing flange 3 inches wide, sealed watertight.
- C. Floor Drain Pans: Formed sheet steel, 14 gage, 0.0747 inch minimum thickness, flat bottom, sloped sides, recessed 1-1/2 inches below floor deck surface, bearing flange 3 inches wide, sealed watertight.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions prior to beginning work.

3.02 INSTALLATION

- A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.
- B. On concrete and masonry surfaces provide minimum 4 inch bearing.
- C. On steel supports provide minimum 1-1/2 inch bearing.
- D. Fasten deck to steel support members at ends and intermediate supports per structural general notes. .
- E. At mechanically fastened male/female side laps fasten at spacing defined on the drawings.
- F. Mechanically fasten side laps.
- G. Drive mechanical sidelap connectors completely through adjacent lapped sheets; positively engage adjacent sheets with minimum three-thread penetration.
- H. At deck openings provide steel angle reinforcement.
- I. Where deck changes direction, install 12 inch (300 mm) minimum wide sheet steel cover plates, of same thickness as deck. Mechanically screw fasten 12" (300 mm) on center maximum.
- J. At floor edges, install concrete stops upturned to top surface of slab, to contain wet concrete. Provide stops of sufficient strength to remain stationary without distortion.
- K. At openings between deck and walls, columns, and openings, provide sheet steel closures and angle flashings to close openings.
- L. Close openings above walls and partitions perpendicular to deck flutes with single row of foam cell closures.

- M. Position roof drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.
- N. Position floor drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.

END OF SECTION

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Shop fabricated steel and galvanized steel items.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.
- B. Section 05 12 00 - STRUCTURAL STEEL FRAMING: Structural steel column anchor bolts.
- C. Section 05 21 00 - Steel Joist Framing: Structural joist bearing plates, including anchorage.
- D. Section 05 31 00 - Steel Decking: Bearing plates for metal deck bearing, including anchorage.
- E. Section 09 91 13 - Exterior Painting: Paint finish.
- F. Section 09 91 23 - Interior Painting: Paint finish.

1.03 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- E. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2013.
- F. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014.
- G. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2014.
- H. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.
- I. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.
- J. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- K. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2014.
- L. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
- M. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.
- N. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; International Accreditation Service, Inc; 2011.

- O. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).
- P. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).
- Q. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.
- D. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel (AC172).

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

- A. Steel Sections: ASTM A36/A36M, except wide flanges ASTM A992, $F_y = 50$ KSI.
- B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
- C. Plates: ASTM A283.
- D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- E. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- F. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 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.
- 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. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FABRICATED ITEMS

- A. Bollards: Steel pipe, concrete filled, crowned cap, as detailed; prime paint finish.
- B. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking; prime paint finish.
- C. Lintels: As detailed; galvanized finish.
- D. Galvanized steel tubing for roof mechanical screen supports.

2.04 FINISHES - STEEL

- A. Prime paint steel items.
 - 1. Exceptions: Galvanize items to be imbedded in masonry.
 - 2. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.
- B. Prepare surfaces to be primed in accordance with SSPC-SP2.
- C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- D. Prime Painting: One coat.
- E. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating.
- F. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.

2.05 FINISHES - ALUMINUM

- A. Exterior Aluminum Surfaces: Class I natural anodized.
- B. Interior Aluminum Surfaces: Class I natural anodized.
- C. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

2.06 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.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components as indicated on drawings.
- D. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Obtain approval prior to site cutting or making adjustments not scheduled.
- F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Communications and electrical room mounting boards.
- B. Concealed wood blocking, nailers, and supports.
- C. Miscellaneous wood nailers, furring, and grounds.
- D. Structural Composite Lumber

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Setting anchors in concrete.
- B. Section 07 25 00 - Weather Barriers: Water-resistive barrier over sheathing.
- C. Section 07 62 00 - Sheet Metal Flashing and Trim: Sill flashings.
- D. Section 09 21 16 - Gypsum Board Assemblies: Gypsum-based sheathing.

1.03 REFERENCE STANDARDS

- A. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- C. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- D. WWSA G-5 - Western Lumber Grading Rules; 2011.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide technical data on application instructions.
- C. Samples: For rough carpentry members that will be exposed to view, submit two samples, ___ by ___ inch in size illustrating wood grain, color, and general appearance.
- D. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.
- E. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. Species: Douglas Fir-Larch, Hem Fir, Spruce-Pine-Fir (South); Western Woods; Southern Pine; or unless otherwise indicated.
 - 2. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
 - 3. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
 - 4. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.
- B. Lumber fabricated from old growth timber is not permitted.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Sizes: Nominal sizes as indicated on drawings, S4S.
- B. Moisture Content: S-dry or MC19.
- C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, No. 1 or Construction Grade.
 - 2. Boards: Standard or No. 3.

2.03 STRUCTURAL COMPOSITE LUMBER (CONCEALED BLOCKING)

- A. Structural Composite Lumber: Factory fabricated beams, headers, and columns, of sizes and types indicated on drawings; structural capacity as published by manufacturer.
 - 1. Blocking: Use laminated veneer lumber, laminated strand lumber, or parallel strand lumber with manufacturer's published E (modulus of elasticity): As defined on the drawings.
 - 2. Manufacturers:
 - a. Weyerhaeuser: www.weyerhaeuser.com.
 - b. Boise Cascade; ____: www.bc.com.
 - c. Georgia-Pacific Corp.; ____: www.buildgp.com.
 - d. Sizes: 1 3/4" X 9 1/4" & 1 3/4" x 16" (cut to size) as shown on drawings.

2.04 CONSTRUCTION PANELS

- A. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
- B. Other Applications:
 - 1. Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.
 - 2. Plywood Exposed to View But Not Exposed to Weather: PS 1, A-D, or better.
 - 3. Other Locations: PS 1, C-D Plugged or better.

2.05 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Metal and Finish: Hot-dipped galvanized steel per ASTM A 153/A 153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
 - 2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
 - 3. Anchors: Toggle bolt type for anchorage to hollow masonry.

PART 3 EXECUTION

3.01 PREPARATION

- A. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

3.03 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- C. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- D. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
- E. Provide the following specific non-structural framing and blocking:
 - 1. Cabinets and shelf supports.
 - 2. Wall brackets.
 - 3. Towel and bath accessories.
 - 4. Wall-mounted door stops.
 - 5. Chalkboards and marker boards.

3.04 INSTALLATION OF CONSTRUCTION PANELS

- A. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
 - 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
 - 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
 - 3. Install adjacent boards without gaps.
 - 4. Size: 48 by 96 inches, installed horizontally at ceiling height.

5. Size and Location: As indicated on drawings.

3.05 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Surface Flatness of Floor: 1/8 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.
- C. Variation from Plane (Other than Floors): 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.06 CLEANING

- A. Waste Disposal: Comply with the requirements of Section 01 74 19 - Construction Waste Management and Disposal.
 - 1. Comply with applicable regulations.
 - 2. Do not burn scrap on project site.
 - 3. Do not burn scraps that have been pressure treated.
 - 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.
- B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

3.07 SCHEDULES

END OF SECTION

SECTION 06 41 00 - ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Specially fabricated cabinet units.
- B. Cabinet hardware.
- C. Factory finishing.
- D. Preparation for installing utilities.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Support framing, grounds, and concealed blocking.
- B. Section 12 36 00 - Countertops.
- C. Section 12 36 00 - Countertops.

1.03 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- B. BHMA A156.9 - American National Standard for Cabinet Hardware; Builders Hardware Manufacturers Association; 2010 (ANSI/BHMA A156.9).

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Minimum Scale of Detail Drawings: 1-1/2 inch to 1 foot.
 - 2. Provide the information required by AWI/AWMAC/WI (AWS).
- C. Product Data: Provide data for hardware accessories.

1.06 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage.

1.08 FIELD CONDITIONS

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Single Source Responsibility: Provide and install this work from single fabricator.

2.02 CABINETS

- A. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI//AWMAC/WI (AWS) for Premium Grade.
- B. Plastic Laminate Faced Cabinets: Custom grade.
- C. Cabinets:
 - 1. Finish - Exposed Exterior Surfaces: Decorative laminate.
 - 2. Finish - Exposed Interior Surfaces: Decorative laminate.
 - 3. Finish - Concealed Surfaces: Manufacturer's option.
 - 4. Door and Drawer Front Edge Profiles: PVC edge banding, 0.12 inch (3 mm) thick, matching laminate in color, pattern, and finish..
 - 5. Casework Construction Type: Type A - Frameless.
 - 6. Grained Face Layout for Cabinet and Door Fronts: Flush panel.
 - a. Custom Grade: Doors, drawer fronts and false fronts wood grain to run and match vertically within each cabinet unit.
 - 7. Adjustable Shelf Loading: 50 lbs. per sq. ft..
 - 8. Cabinet Style: Flush overlay.
 - 9. Cabinet Doors and Drawer Fronts: Flush style.

2.03 LAMINATE MATERIALS

- A. Manufacturers:
 - 1. Formica Corporation; ____: www.formica.com.
 - 2. Panolam Industries International, IncNevamar; ____: www.nevamar.com.
 - 3. Wilsonart, LLC; ____: www.wilsonart.com.
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
- C. Provide specific types as scheduled.
 - 1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness, colors as scheduled, finish as scheduled.
 - 2. Vertical Surfaces: VGS, 0.028 inch nominal thickness, colors as scheduled, finish as scheduled.
 - 3. Post-Formed Horizontal Surfaces: HGP, 0.039 inch nominal thickness, colors as scheduled, finish as scheduled.
 - 4. Cabinet Liner: CLS, 0.020 inch nominal thickness, colors as scheduled, finish as scheduled.

2.04 COUNTERTOPS (SEE SECTION 12 36 00-COUNTERTOPS)

- A. Countertops are specified in Section 12 36 00.

2.05 ACCESSORIES

- A. Adhesive: Type recommended by fabricator to suit application.

- B. Plastic Edge Banding: Extruded PVC, convex shaped; smooth finish; self locking serrated tongue; of width to match component thickness.
 - 1. Color: As selected by Architect from manufacturer's standard range.
- C. Fasteners: Size and type to suit application.
- D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
- E. Concealed Joint Fasteners: Threaded steel.
- F. Grommets: Standard plastic grommets for cut-outs, in color to match adjacent surface.
- G. Tackboards: Same as Claridge "Fabricork" vinyl tack board No. 1550-EW or approved equal. Color as selected by Architect.
- H. Countertop Support Bracket: Provide countertop support brackets (a.k.a. work station brackets) as manufactured by A&M Hardware, Inc. of Manheim, PA 17545 (888-647-4582). Furnish size to fit appropriate countertop depth. Brackets shall be made of 1/8" steel, capable of supporting 1000# load limit. Colors shall be selected from standard textured powder coat finishes.
- I. Standoffs: Provide satin stainless steel standoffs as manufactured by Doug Mockett and Company, Manhattan Beach, Calif. 800-523-1269 or equal. 1 1/4" cap with 1" barrel height. Include mounting hardware appropriate for wall type designated.

2.06 HARDWARE

- A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.
- B. Adjustable Shelf Supports: Standard side-mounted system using multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch spacing adjustments.
- C. Drawer and Door Pulls: "U" shaped wire pull, steel with satin finish, 4 inch centers.
- D. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish.
- E. Catches: Magnetic.
- F. Closet Rails and Supports: Provide same as Hafele "Oval" chrome plated closet rail, Model #801.13 and Model #803.33.722 nickel plated support for inserion in 32 mm system holes, with attached dowels and an additional screw hole.
- G. Drawer Slides:
 - 1. Type: Extension types as scheduled.
 - 2. Static Load Capacity: Commercial grade.
 - 3. Mounting: Side mounted.
 - 4. Stops: Integral type.
 - 5. Features: Provide self closing/stay closed type.
 - 6. Products:
 - a. Accuride International, Inc; ____: www accuride.com.
 - b. Grass America Inc; ____: www.grassusa.com.
 - c. Hettich America, LP; ____: www.hettichamerica.com.
 - d. Knap & Vogt Manufacturing Company; ____: www.knapandvogt.com.
- H. Hinges: Butt self-closing type, BHMA No. A156.9, BO1521, steel with satin finish.

1. 2-3/4" inch (70 mm), 5-knuckle, steel hinges made from 0.095 inch (2.4 mm) thick, metal. Semiconcealed hinges for flush doors.
 - a. Products:
 - 1) Grass America Inc; _____: www.grassusa.com.
 - 2) Hardware Resources; _____: www.hardwareresources.com.
 - 3) Hettich America, LP; Sensys: www.hettichamerica.com.
 - 4) Julius Blum, Inc; _____: www.blum.com.
 - 5) Substitutions: See Section 01 60 00 - Product Requirements.

2.07 FABRICATION

- A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
 1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
 2. Cap exposed plastic laminate finish edges with material of same finish and pattern.
- E. Mechanically fasten back splash to countertops as recommended by laminate manufacturer at 16 inches on center.
- F. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

- A. Set and secure custom cabinets in place, assuring that they are 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.
- 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 to floor using appropriate angles and anchorages.
- F. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.03 ADJUSTING

- A. Adjust installed work.

B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 07 21 00 - THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Board insulation at cavity wall construction and perimeter foundation wall.
- B. Batt insulation for filling crevices in exterior wall and roof.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Field-applied termiticide for concrete slabs and foundations.
- B. Section 06 10 00 - Rough Carpentry: Supporting construction for batt insulation.
- C. Section 07 25 00 - Weather Barriers: Separate air barrier and vapor retarder materials.
- D. Section 07 52 00 - Modified Bituminous Membrane Roofing: Insulation specified as part of roofing system.
- E. Section 07 52 00 - Modified Bituminous Membrane Roofing: Installation requirements for board insulation over low slope roof deck specified in this section.
- F. Section 07 84 00 - Firestopping: Insulation as part of fire-rated through-penetration assemblies.

1.03 REFERENCE STANDARDS

- A. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2015.
- B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2015a.
- C. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- D. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2014.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- F. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2012.
- G. ASTM E2357 - Standard Test Method for Determining Air Leakage of Air Barrier Assemblies; 2011.
- H. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components; 2012.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

1.05 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 APPLICATIONS

- A. Insulation at Perimeter of Foundation: Expanded polystyrene board.
- B. Insulation Inside Masonry Cavity Walls: Extruded polystyrene board.

2.03 FOAM BOARD INSULATION MATERIALS

- A. Termite-Resistant Expanded Polystyrene (EPS) Board Insulation: Complies with ASTM C578 with the following characteristics:
 - 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 - 3. Board Size: 48 by 96 inch.
 - 4. Board Thickness: 3 inches.
- B. Extruded Polystyrene Board Insulation: Extruded polystyrene board; ASTM C578; with either natural skin or cut cell surfaces, and the following characteristics:
 - 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 - 3. R-value; 1 inch of material at 72 degrees F: 5, minimum.
 - 4. Complies with fire resistance requirements shown on the drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
 - 5. Board Size: 24 x 96 inch.
 - 6. Board Thickness: 2 inches.
 - 7. Board Edges: Square.
 - 8. Thermal Resistance: R-value of 4.6 per 1 inch at 75 degrees F mean temperature.
 - 9. Compressive Resistance: 15 psi.
 - 10. Board Density: 1.20 lb/cu ft.
 - 11. Water Absorption, Maximum: 0.3 percent, by volume.
 - 12. Manufacturers:
 - a. Dow Chemical Co: www.dow.com.
 - b. Owens Corning Corporation; FOAMULAR Extruded Polystyrene (XPS) Insulation: www.ocbuildingspec.com.
 - c. Owens Corning Corp: www.owenscorning.com.
 - d. Kingspan Insulation LLC; GreenGuard XPS TYPE IV 25 PSI: www.trustgreenguard.com.
 - 13. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 BATT INSULATION MATERIALS

- A. Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used, at Contractor's option.

- B. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
 - 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 - 3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
 - 4. Thickness: 6 inch.
 - 5. Facing: Aluminum foil, flame spread 25 rated; one side.
 - 6. Manufacturers:
 - a. CertainTeed Corporation: www.certainteed.com.
 - b. Johns Manville: www.jm.com.
 - c. Owens Corning Corp: www.owenscorning.com.
 - 7. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
 - 1. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
 - 2. Thickness: 3 1/2" or 6" inch.

2.05 ACCESSORIES

- A. Tape: Bright aluminum self-adhering type, mesh reinforced, 2 inch wide.
- B. Sill Sealer: equal to Owens Corning Foam SealR Sill Plate Gasket 1/4" thick by 5 1/2" wide at all exterior metal stud wall / foundation locations.
- C. Metal Banding Straps: metal banding strapping of sufficient strength to support unfaced sound batt insulation at bottom chord of metal roof trusses.
- D. Tape joints of rigid insulation in accordance with roofing and insulation manufacturers' instructions.
- E. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.
- F. Nails or Staples: Steel wire; electroplated or galvanized; type and size to suit application.
- G. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER

- A. Apply adhesive to back of boards:
 - 1. Three continuous beads per board length.
- B. Install boards vertically on foundation perimeter.
 - 1. Butt edges and ends tightly to adjacent boards and to protrusions.

- C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.03 BOARD INSTALLATION AT CAVITY WALLS

- A. Install boards to fit snugly between wall ties.
- B. Install boards horizontally on walls.
- C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.04 BATT INSTALLATION

- A. Install insulation in accordance with manufacturer's instructions.
- B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
- E. Staple or nail facing flanges in place at maximum 6 inches on center.
- F. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.
- G. Space metal strapping as required to adequately support span of exposed sound batt insulation.

3.05 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 07 27 26 - FLUID APPLIED MEMBRANE AIR BARRIERS

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 materials and installation of vapor permeable fluid applied air and moisture barrier membrane over vertical above grade concrete walls, concrete masonry walls, and wall sheathing.
- B. Related Requirements:
 - 1. Section 03 30 00: Cast-In-Place Concrete
 - 2. Section 04 22 00: Concrete Unit Masonry
 - 3. Section 07 25 00: Weather Barriers
 - 4. Section 07 60 00: Flashing and Sheet Metal

1.03 DEFINITIONS

- A. Air Barrier Material: A primary element that provides a continuous barrier to the movement of air.
- B. Air Barrier Accessory: A transitional component of the air barrier that provides continuity.
- C. Air Barrier Auxiliary Material: A transitional component that provides air barrier continuity furnished by a source other than the primary air barrier manufacturer.
- D. Air Barrier Assembly: The collection of air barrier materials, accessory and auxiliary materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.04 PRE-INSTALLATION MEETINGS

- A. Pre-installation Conference
 - 1. Review air barrier installation requirements and installation details, mock-ups, testing requirements, protection, and sequencing of work.

1.05 REFERENCES

- A. ASTM Standards
 - 1. C 297-94 Test Method for Tensile Strength of Flat Sandwich Constructions in Flat wise Plane
 - 2. C 1177-08 Specification for Glass Mat Gypsum Substrate for Use as Sheathing
 - 3. D 522-93a Test Methods for Mandrel Bend Test of Attached Organic Coatings
 - 4. D 1970-00 Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
 - 5. D 3273-00 Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber

6. D 4541-09 Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
 7. E 84-98 Test Method for Surface Burning Characteristics of Building Materials
 8. E 96-00 Test Method for Water Vapor Transmission of Materials
 9. E 779-10 Standard Test Method for Determining Air Leakage Rate by Fan Pressurization
 10. E 783-02 Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors
 11. E 1186-03 (2009) Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems
 12. E 1827-96 (2007) Standard Test Methods for Determining Air Tightness of Buildings Using an Orifice Blower Door
 13. E 2178-03 Test Method for Air Permeance of Building Materials
 14. E 2357-05 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies
- B. APA - The Engineered Wood Association
1. E30U-2007 Engineered Wood Construction Guide
- C. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)
1. 2005 ASHRAE Handbook Fundamentals
 2. ASHRAE 90.1 2010, Energy Standard for Buildings Except Low-Rise Residential Buildings
 3. ASHRAE 189.1 2009, Standard for the Design of High Performance Green Buildings Except Low-Rise Residential Buildings
- D. National Fire Protection Association (NFPA)
1. NFPA 285 Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components
- E. South Coast Air Quality Management District (SCAQMD)
1. Rule 1113 (2007) Architectural Coatings

1.06 COORDINATION/SCHEDULING

- A. Coordinate installation of foundation waterproofing, roofing membrane, windows, doors and other wall penetrations to provide a continuous air barrier.
- B. Provide protection of rough openings before installing windows, doors, and other penetrations through the wall.
- C. Provide sill flashing to direct water to the exterior before windows and doors are installed.
- D. Install window and door head flashing immediately after windows and doors are installed.
- E. Install diverter flashings wherever water can enter the assembly to direct water to the exterior.
- F. Install parapet cap flashing and similar flashing at copings and sills to prevent water entry into the wall assembly.
- G. Install cladding within 180 days of air and moisture barrier installation.

1.07 SUBMITTALS

- A. Manufacturer's specifications, details and product data.
- B. Manufacturer's standard warranty.

- C. Manufacturer's ICC evaluation report confirming compliance with the IBC, IRC, and IECC as an air barrier and water-resistive barrier.
- D. Samples for approval as directed by architect or owner.
- E. Shop drawings: substrate joints, cracks, flashing transitions, penetrations, corners, terminations, and tie-ins with adjoining construction, and interfaces with separate materials that form part of the air barrier assembly.

1.08 QUALITY ASSURANCE

- A. Manufacturer requirements
 - 1. Manufacturer of exterior wall air and moisture barrier materials for a minimum of 30 years in North America.
 - 2. ISO 9001:2008 Certified Quality System and ISO 14001:2004 Certified Environmental Management System.
- B. Contractor requirements
 - 1. Knowledgeable in the proper use and handling of Sto materials.
 - 2. Employ skilled mechanics who are experienced and knowledgeable in waterproofing and air barrier application, and familiar with the requirements of the specified work.
 - 3. Provide the proper equipment, manpower and supervision on the job-site to install the air barrier assembly in compliance with the project plans & specifications, shop drawings, and Sto's published specifications and details.
- C. Regulatory Compliance
 - 1. Primary air barrier and joint treatment reinforcement materials:
 - a. Listed by IBC and recognized for use on all types of construction. Refer to ICC ESR 1233 for limitations.
 - b. Comply with VOC requirements of SCAQMD Rule 1113.
 - c. Comply with air barrier material requirements of ASHRAE 90.1 - 2010, 2013
 - d. Comply with air barrier material requirements of ASHRAE 189.1 - 2009
 - e. Comply with 2012 and 2015 IRC requirement for a continuous air barrier
 - f. Comply with air barrier material requirements of 2012 and 2015 IBC and IECC.
- D. Mock-ups
 - 1. Build stand-alone site mock up or sample wall area on as-built construction to incorporate back-up wall construction, typical details covering substrate joints, cracks, flashing transitions, penetrations, corners, terminations, tie-ins with adjoining construction, and interfaces with separate materials that form part of the air barrier assembly.

1.09 PRE-CONSTRUCTION TESTING

- A. Conduct testing by qualified test agency or building envelope consultant.
 - 1. Conduct assembly air leakage testing in accordance with ASTM E 783.
 - 2. Conduct adhesion testing to substrates in accordance with ASTM D 4541.
 - 3. Conduct wet sealant compatibility testing in accordance with sealant manufacturer's field quality control test procedure.
 - 4. Notify design professional minimum 7 days prior to testing.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials in their original sealed containers bearing manufacturer's name and identification of product.

- B. Protect coatings (pail products) from freezing temperatures and temperatures in excess of 90 degrees F (32 degrees C). Store away from direct sunlight.
- C. Protect Portland cement based materials (bag products) from moisture and humidity. Store under cover off the ground in a dry location.
- D. Protect and store accessory and auxiliary products in accordance with manufacturer's written instructions.

1.11 PROJECT/SITE CONDITIONS

- A. Maintain ambient and surface temperatures above 40 degrees F (4 degrees C) during application and drying period, minimum 24 hours after application of air and moisture barrier materials.
- B. Provide supplementary heat for installation in temperatures less than 40 degrees F (4 degrees C) or if surface temperature is likely to fall below 40 degrees F (4 degrees C).
- C. Provide protection of surrounding areas and adjacent surfaces from application of materials.

1.12 WARRANTY

- A. Provide manufacturer's standard warranty.

1.13 PRODUCTS

1.14 MANUFACTURERS

- A. Sto Corp.
- B. Obtain primary air barrier and accessory air barrier materials from single source.

1.15 MATERIALS

- A. Primary Air Barrier Material: StoGuard with Sto EmeraldCoat - ready-mixed flexible spray or roller applied air and moisture barrier material.
- B. Accessory Materials
 - 1. Sheathing Joint Treatments (select one)
 - a. StoGuard RapidFill™: one component rapid drying gun-applied joint treatment for sheathing joints.
 - b. Sto Gold Fill® with StoGuard Mesh: ready mixed coating applied by trowel or knife over nominal 4.2 oz/yd² (142 g/m²) self-adhesive, flexible, symmetrical, interlaced glass fiber mesh.
 - c. Sto EmeraldCoat® with StoGuard Fabric: flexible air and moisture barrier membrane material for embedding non-woven integrally reinforced cloth reinforcement.
 - 2. Rough Opening Treatments (select one)
 - a. StoGuard RapidSeal: one component rapid drying gun-applied rough opening protection for frame and CMU walls. Also used as a detail component for shingle lap transition at flashing.
 - b. Sto EmeraldCoat with StoGuard Fabric and StoGuard Redicorner™: flexible waterproof air barrier membrane material with non-woven integrally reinforced cloth reinforcements. Also used as a detail component for shingle lap transition at flashing.
 - c. Sto Gold Fill with StoGuard Mesh: ready mixed coating applied by trowel or knife with nominal 4.2 oz/yd² (142 g/m²) self-adhesive, flexible, symmetrical, interlaced

- glass fiber mesh. Also used as a detail component for shingle lap transition at flashing.
 - d. StoGuard Tape: self-adhered rubberized asphalt tape for frame walls with polyester fabric facing.
 - 3. Transition Membrane
 - a. StoGuard Transition Membrane: flexible air barrier membrane for continuity at transitions: sheathing to foundation, dissimilar materials (CMU to frame wall), wall to balcony floor slab or ceiling, flashing shingle lap transitions, floor line deflection joints, masonry control joints, and through wall joints in masonry or frame construction.
 - b. StoGuard RapidFill: one component gun-applied air and moisture barrier membrane material for continuity at static transitions such as: flashing shingle laps, wall to balcony floor slab or ceiling, and through wall penetrations such as pipes, electrical boxes, and scupper penetrations.
 - 4. Sealant
 - a. StoGuard RapidSeal - one component rapid drying air and moisture barrier membrane material for sealing fish mouths, wrinkles, seams, gaps, holes, or other voids in StoGuard air barrier materials
 - b. StoGuard RapidFill - one component rapid drying waterproof air and moisture barrier membrane material for sealing fish mouths, wrinkles, seams, gaps, holes, or other voids in StoGuard air barrier materials
 - 5. Primers
 - a. StoGuard Primer: rubber resin emulsion primer for use with StoGuard Tape to enhance adhesion.
- C. Auxiliary Materials (by others)
 - 1. Wet sealant: Dow Corning 758, 790, 791, and 795 sealants
 - 2. Pre-cured sealant tape: Dow 123
 - 3. Spray adhesive: 3M Super 77 Spray Adhesive
 - 4. Spray foam: Dow Great Stuff for Gaps and Cracks
- D. Patch and Leveling Material for Concrete and Masonry
 - 1. Sto Leveler: polymer modified cementitious patch and leveling material for prepared concrete and masonry surfaces for leveling up to 1/4 inch (6 mm).
 - 2. Sto BTS-Xtra: polymer modified lightweight cementitious patch and leveling material for prepared concrete and masonry surfaces for leveling up to 1/8 inch (3 mm).

1.16 PERFORMANCE REQUIREMENTS

- A. Durability, resistance to aging, water and water penetration resistance, structural loading: joint treatment and primary air barrier material, comply with ICC ES AC 212
- B. Flexibility: ASTM D 522, primary air barrier material, no cracking or delamination before and after aging using 1/8 inch (3 mm) mandrel at 14° F (10° C)
- C. Nail sealability: ASTM D 1970, 7.9.1, primary air barrier passes
- D. Resistance to mold: ASTM D 3273, no mold growth after 28 day exposure
- E. Adhesion: joint treatment and primary air barrier material, ASTM C 297 or D 4541, > 30 psi (207 kPa), or exceeds strength of glass mat facing on glass mat gypsum substrates
- F. Surface burning: ASTM E 84, joint treatment and primary air barrier material flame spread < 25, smoke developed < 450, Class A building material

- G. Water vapor permeance: ASTM E 96 Method B, > 10 perms (570 ng/Pa·s·m²)
- H. Field adhesion testing: ASTM D 4541, > 30 psi (207 kPA) or exceeds strength of glass mat facing on glass mat gypsum substrates
- I. Fire resistance: ASTM E 119, permitted for use in exterior walls of fire-resistance-rated construction assemblies. Refer to ICC-ESR 1233.
- J. Building envelope air leakage: ASTM E 779 or 1827, < 0.4 cfm/ft² (2 L/s·m²)
- K. Material air leakage: ASTM E 2178, primary air barrier and joint treatment < 0.004 cfm/ft² at 1.57 psf (0.02 L/s·m² at 75 Pa)
- L. Assembly air leakage: ASTM E 2357, < 0.04 cfm/ft² (0.2 L/s·m²) air leakage after conditioning protocol
- M. Fire propagation: NFPA 285, meets requirements for use on all Types of construction. Refer to ICC-ESR 1233.
- N. Volatile Organic Compounds: SCAQMD Rule 1113, joint treatment and primary air barrier material < 100 g/L
- O. Water-resistive barrier: ICC ES 212, joint treatment and primary air barrier comply and are listed in a valid ICC ESR.

1.17 DESIGN CRITERIA

- A. Structural (Wind and Axial Loads)
 - 1. Design for maximum allowable deflection normal to the plane of the wall: L/240. Where cladding dictates stiffer deflection criteria use cladding design criteria for maximum allowable deflection.
 - 2. Design for wind load in conformance with code requirements.
- B. Moisture Control
 - 1. Prevent the accumulation of water in the wall assembly and behind the exterior wall cladding:
 - a. Minimize condensation within the assembly.
 - b. Drain water directly to the exterior where it is likely to penetrate components in the wall assembly (windows and doors, for example).
 - c. Provide corrosion resistant flashing to direct water to the exterior in accordance with code requirements, including: above window and door heads, beneath window and door sills, at roof/wall intersections, floor lines, decks, intersections of lower walls with higher walls, and at the base of the wall.
- C. Air Barrier Continuity: provide continuous air barrier assembly of compatible air barrier components.
- D. Substrates
 - 1. Concrete Masonry Units: provide CMU surfaces in conformance with the applicable building code, and such that a void and pinhole free air barrier is achieved. Provide normal weight units with flush joints (struck flush with the surface) and allow for a minimum of 2 coats of the primary air barrier material applied by spray or roller. Alternatively, for “rough” CMU wall surfaces allow for a cementitious parge coat to fill and level irregular surfaces, prior to 1 coat of the primary air barrier material.
 - 2. Concrete: provide concrete in conformance with the applicable building code.

3. Sheathing: provide gypsum sheathing in compliance with ASTM C 1177, provide APA Exterior or Exposure 1 wood-based sheathing, and provide sheathing that meets required design wind pressures.
- E. Mechanical Ventilation: maintain pressurization and indoor humidity levels in accordance with recommendations of ASHRAE (see 2005 ASHRAE Handbook-Fundamentals).

1.18 EXECUTION

1.19 EXAMINATION

- A. Inspect concrete and concrete masonry surfaces for:
1. Contamination - algae, dirt, dust, efflorescence, form oil, fungus, grease, mildew or other foreign substances.
 2. Surface deficiencies - weak, friable, chalkiness, laitance, bugholes, and spalls.
 3. Cracks - measure crack width and record location of cracks.
 4. Damage or deterioration.
 5. Moisture content and moisture damage - use a moisture meter to determine if the surface is dry enough to receive the waterproof air barrier and record any areas of moisture damage or excess moisture.
 6. Flush masonry mortar joints completely filled with mortar.
- B. Inspect sheathing application for compliance with applicable requirement:
1. Exterior Grade and Exposure I wood based sheathing: E30U-2007, Engineered Wood Construction Guide, and the requirements of the applicable building code.
 2. Glass mat faced gypsum sheathing in compliance with ASTM C 1177: consult manufacturer's published recommendations and ICC ES Report. Conform with project requirements for wind load resistance.
 3. Cementitious sheathing - Consult manufacturer's published recommendations and ICC ES Report. Conform with project requirements for wind load resistance.
- C. Report deviations from the requirements of project specifications or other conditions that might adversely affect the air and moisture barrier installation. Do not start work until deviations are corrected.

1.20 SURFACE PREPARATION

- A. Concrete Masonry
1. Surface must be structurally sound and free of weak or damaged surface conditions such as laitance or spalls. Surface must be clean, dry, frost-free, and free of any bond-inhibiting materials such as dust, dirt, oil, algae, mildew, salts, efflorescence, or any other surface contamination. Mortar joints must be struck flush with the surface.
 2. Remove excess mortar from masonry ties, lintels and shelf angles.
 3. Remove loose or damaged material by water-blasting, sandblasting or mechanical wire brushing. Remove surface contamination such as dirt or efflorescence by chemical or mechanical means. Repair surface defects such as spalls, voids and holes with Sto BTS Xtra (up to 1/8 inch [3 mm] thick) or Sto Leveler (up to 1/4 inch [6 mm] thick).
 4. Repair non-structural cracks up to 1/8 inch (3 mm) wide by raking with a sharp tool to remove loose, friable material and blow clean with oil-free compressed air. Apply joint treatment material over crack, embed reinforcement (where applicable), and smooth joint treatment material with a trowel, drywall or putty knife to cover the reinforcement.
- B. Concrete

1. Surface must be structurally sound and free of weak or damaged surface conditions such as laitance, bugholes, or spalls. Surface must be clean, dry, frost-free, and free of any bond-inhibiting materials such as dust, dirt, oil, form release, algae, mildew, salts, efflorescence, or any other surface contamination.
2. Remove projecting fins, ridges, form ties, and high spots by mechanical means.
3. Remove loose or damaged material by water-blasting, sandblasting or mechanical wire brushing. Remove form release by chemical or mechanical means. Repair surface defects such as honeycombs, pitting, spalls, voids or holes with Sto BTS Xtra (up to 1/8 inch [3 mm] thick) or Sto Leveler (up to 3/8 inch [9 mm] thick).
4. Repair non-structural cracks up to 1/8 inch (3 mm) wide by raking with a sharp tool to remove loose, friable material and blow clean with oil-free compressed air. Apply joint treatment material over crack, embed reinforcement (where applicable), and smooth joint treatment material with a trowel, drywall or putty knife to cover the reinforcement.

C. Sheathing

1. Remove and replace damaged sheathing.
2. Spot surface defects such as over-driven fasteners, knot holes, or other voids in sheathing with knife grade joint treatment material.
3. Spot fasteners with knife grade or coating joint treatment material.

1.21 INSTALLATION

1.22 AIR/MOISTURE BARRIER INSTALLATION OVER EXTERIOR OR EXPOSURE I WOOD-BASED SHEATHING (PLYWOOD AND OSB), GLASS MAT FACED GYPSUM SHEATHING IN COMPLIANCE WITH ASTM C 1177, CONCRETE, AND CONCRETE MASONRY (CMU) WALL CONSTRUCTION

- A. Coordinate work with other trades to ensure air barrier continuity with connections at foundation, floor lines, flashings, lintels and shelf angles, openings and penetrations such as pipes, vents, windows and doors, masonry anchors, rafters or beams, joints in construction, projections such as decks and balconies, and roof line.
- B. Transition Membrane Detailing: detail transition areas with StoGuard Transition Membrane to achieve air barrier continuity. For illustrations of installation, including complex geometries such as inside and outside corners, refer to Sto Guide Details and StoGuard Transition Membrane Installation Guide (www.stocorp.com).
- C. Floor line deflection joints up to 1 inch (25 mm) wide, static joints and transitions - sheathing to foundation, dissimilar materials (CMU to frame wall), flashing shingle lap transitions, wall to balcony floor slab or ceiling:
 1. Apply air and moisture barrier coating (Sto EmeraldCoat) liberally to properly prepared surfaces with brush, roller, or spray.
 2. Place pre-cut lengths of StoGuard Transition Membrane centered over the transition in the wet coating. At changes in plane crease the membrane and similarly place the membrane material in the wet coating.
 3. Immediately top coat the membrane with additional coating and apply pressure with brush or roller to fully embed the membrane in the coating and achieve a smooth and wrinkle-free surface without gaps or voids.
 4. Apply coating liberally along all top horizontal edges on walls and along all edges on balcony floor slabs to fully seal the edges.

5. Overlap minimum 2 inches (51 mm) at ends and adhere lap seams together with coating. Shingle lap vertical seams and vertical to horizontal intersections with minimum 2 inch (51 mm) overlap.
- D. Movement joints up to 1 inch (25 mm) wide and up to + 50% movement: masonry control joints, through wall joints in masonry or frame construction
1. Insert backer rod sized to friction fit in the joint (diameter 25% greater than joint width).
 2. Recess the backer rod ½” (13 mm).
 3. Apply the waterproof coating liberally to properly prepared surfaces with brush, roller, or spray along each side of the joint (not in the joint).
 4. Immediately place the membrane by looping it into the joint against the backer rod surface to provide slack.
 5. Embed the membrane in the wet coating along the sides of the joint by top coating with additional coating material and applying pressure with a brush or roller.
- E. After the membrane installation is complete and the air and moisture barrier coating is dry:
1. Apply a final liberal coat of the coating to all top horizontal edges on walls to ensure waterproofing integrity. Similarly apply coating at all edges on balcony floor slabs.
 2. Inspect the installed membrane for fish mouths, wrinkles, gaps, holes or other deficiencies. Correct fish mouths or wrinkles by cutting, then embedding the area with additional coating applied under and over the membrane.
 3. Seal gaps, holes, and complex geometries at three dimensional corners with StoGuardRapidSeal or StoGuard RapidFill.
- F. Rough opening protection (select one):
1. Install rough opening protection. Refer to Sto details 20.20M, 20.20F, 20.20FT, 20.20T, 20.20R, 21.20G, and 21.20R and applicable Sto product bulletins.
- G. Sheathing joints
1. Install joint treatment material with applicable reinforcement over sheathing joints. Refer to Sto detail 20.00a and applicable Sto product bulletins.
- H. Air and moisture barrier coating
1. Concrete - install one coat of Sto EmeraldCoat by spray or roller in a uniform, continuous wet film of 10 mils to the prepared concrete substrate. Do not install over working or moving joint sealants.
 2. Concrete Masonry - install one liberal coat of Sto EmeraldCoat by spray or roller in a uniform, continuous film to the prepared concrete masonry substrate. Backroll spray applications. Allow to dry. Install a second liberal coat in a uniform, continuous film, and backroll spray applications, to achieve a void and pinhole free surface. Depending on the condition of the surface a minimum of 10 wet mils up to a maximum of 30 wet mils per coat is required. Apply additional coats if needed to achieve a void and pinhole free surface. Do not install over working or moving joint sealants.
 3. Sheathing
 - a. Glass mat faced gypsum sheathing: install one coat of Sto EmeraldCoat by spray or roller in a uniform, continuous film of 10 wet mils to the prepared glass mat gypsum substrate to achieve a void and pinhole free surface. Do not install over working or moving joint sealants.
 - b. Plywood sheathing: install one coat of Sto EmeraldCoat by spray or roller in a uniform, continuous film of 10 wet mils to the prepared substrate to achieve a void and pinhole free surface. Do not install over working or moving joint sealants.

- c. OSB sheathing: install one coat of Sto EmeraldCoat by spray or roller in a uniform, continuous film of 10 wet mils to the prepared substrate and to a void and pinhole free surface. Inspect surface and touch-up with a second coat at raised wood strands. Do not install over working or moving joint sealants.

1.23 FIELD QUALITY CONTROL

- A. Owner's qualified testing agency or building envelope consultant shall perform inspections and tests.
- B. Inspections: air barrier materials are subject to inspection to verify compliance with requirements.
 - 1. Condition of substrates and substrate preparation.
 - 2. Installation of primary air barrier material, accessory materials, and compatible auxiliary materials over structurally sound substrates and in conformance with architectural design details, contractor's shop drawings, project mock-up, and manufacturer's written installation instructions.
 - 3. Air barrier continuity and connections without gaps and holes at foundation, floor lines, flashings, lintels and shelf angles, openings and penetrations such as pipes, vents, windows and doors, masonry anchors, rafters or beams, joints in construction, projections such as decks and balconies, and roof line.
- C. Tests: air barrier materials and assembly are subject to tests to verify compliance with performance requirements:
 - 1. Qualitative air leakage test: ASTM E 1186
 - 2. Quantitative air leakage test: ASTM E 779, E 783, and E 1827
 - 3. Adhesion test: ASTM D 4541
 - 4. Qualitative adhesion and compatibility testing: wet sealant manufacturer's field quality control adhesion test
- D. Repair non-conforming substrates and air barrier material installation to conform with project requirements.
- E. Take corrective action to repair and replace, reinstall, seal openings, gaps, or other sources of air leakage to conform with project performance requirements.

1.24 PROTECTION AND CLEANING

- A. Protect air barrier materials from damage during construction caused by wind, rain, freezing, continuous high humidity, or prolonged exposure to sun light.
- B. Protect air barrier materials from damage from trades, vandals, and water infiltration during construction.
- C. Repair damaged materials to meet project specification requirements.
- D. Clean spills, stains, soiling from finishes or other construction materials that will be exposed in the completed work with compatible cleaners.
- E. Remove all masking materials after work is completed.

END OF SECTION

SECTION 07 52 00 - MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Modified bituminous roofing membrane, conventional application.
- B. Insulation, flat and tapered.
- C. Deck sheathing.
- D. Base flashings.
- E. Roofing cant strips, accessories, roofing expansion joints, and walkway pads.

1.02 RELATED REQUIREMENTS

- A. Section 05 31 00 - Steel Decking : Product requirements for acoustical insulation for deck flutes, for placement by this section.
- B. Section 06 10 00 - Rough Carpentry: Wood nailers and curbs.
- C. Section 07 62 00 - Sheet Metal Flashing and Trim: Counterflashings, reglets and _____.
- D. Section 07 72 00 - Roof Accessories: Roof-mounted units.
- E. Section 07 72 00 - Roof Accessories: Prefabricated curb for mechanical equipment.
- F. Section 22 10 06 - Plumbing Piping Specialties: Roof drains.

1.03 REFERENCE STANDARDS

- A. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2014.
- B. ASTM D41/D41M - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing; 2011.
- C. ASTM D312/D312M - Standard Specification for Asphalt Used in Roofing; 2015.
- D. ASTM D2178/D2178M - Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing; 2013a.
- E. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2012).
- F. ASTM D4897/D4897M - Standard Specification for Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing; 2001 (Reapproved 2009).
- G. ASTM D6163/D6163M - Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements; 2000 (Reapproved 2015).
- H. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- I. FM DS 1-28 - Wind Design; 2007.
- J. NRCA ML104 - The NRCA Roofing and Waterproofing Manual; National Roofing Contractors Association; Fifth Edition, with interim updates.
- K. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- L. UL (FRD) - Fire Resistance Directory; current edition.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of associated flashings and counterflashings installed by other sections.
- B. Preinstallation Meeting: Convene one week before starting work of this section.
 - 1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's catalog data for membrane and bitumen materials, base flashing materials, insulation, vapor retarder, and surfacing.
- C. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, setting plan for tapered insulation, mechanical fastener layout, and _____.
- D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

- A. Perform work in accordance with NRCA Roofing and Waterproofing Manual and manufacturer's instructions.
 - 1. Maintain one copy on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of experience.
- C. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience _____.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.
- B. Store products in weather protected environment, clear of ground and moisture; ballast materials may be stored outdoors.
- C. Protect foam insulation from direct exposure to sunlight.

1.08 FIELD CONDITIONS

- A. Do not apply roofing membrane when environmental conditions are outside the ranges recommended by manufacturer.
- B. Do not apply roofing membrane during unsuitable weather.
- C. Do not apply roofing membrane when ambient temperature is below 40 degrees F.
- D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

1.09 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a two year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Membrane Materials:
 - 1. GAF: www.gaf.com.
 - 2. Johns Manville Roofing
 - 3. Firestone Building Products Company; _____: www.firestonebpco.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation:
 - 1. GAF; _____: www.gaf.com.
 - 2. Hunter Panels, LLC; _____: www.hpanels.com.
 - 3. A.C. Foam Atlas Roofing, www.atlasroofing.com.

2.02 ROOFING - CONVENTIONAL APPLICATION

- A. Modified Bituminous Roofing: Two-ply membrane, with insulation.
- B. Roofing Assembly Requirements:
 - 1. Wind Resistance Classification: Factory Mutual I-75, in accordance with FM DS 1-28.
 - 2. Surfacing: Mineral granules.
- C. Acceptable Insulation Types - Constant Thickness Application: Any of the types specified.
 - 1. Single layer of polyisocyanurate board.
 - 2. Tapered insulation crickets where required and shown on drawings.
 - 3. 1/2" High-Density wood fiber cover board

2.03 MEMBRANE AND SHEET MATERIALS

- A. Membrane: Polymer modified asphalt, reinforced with non-woven fabric; granule surfaced; with the following characteristics: equal to U.S. Ply Duraflex SBS capsheet (G4M)
 - 1. Color: White.
- B. Base Sheet: Heavy weight modbit base sheet per ASTM. equal to U.S. Ply Duraflex 60 base.
- C. Flexible Flashing Material: Same material as membrane.

2.04 BITUMINOUS MATERIALS

- A. Bitumen: Asphalt, ASTM D312 Type IV;
- B. Primer: ASTM D41/D41M, asphalt type.
- C. Roof Cement: ASTM D4586/D4586M, Type II.

2.05 DECK SHEATHING AND COVER BOARDS

- A. 1/2" high density wood fiber or perlite board equal to Hubert Fiberboard.

2.06 INSULATION

- A. Polyisocyanurate Board Insulation: Rigid cellular foam, complying with ASTM C1289, Type I, aluminum foil both faces; Class 1, non-reinforced foam core, and with the following characteristics:
 - 1. Board Size: 48 by 96 inch.
 - 2. Board Thickness: 3.0 inch.
 - 3. Tapered Board: Slope as indicated; minimum thickness 3/4 inch; fabricate of fewest layers possible.
 - 4. Thermal Resistance: R-value of 17.4.
 - 5. Board Edges: Square.
 - 6. Manufacturers:
 - a. Atlas Roofing
 - b. Hunter Panels, LLC; _____: www.hpanels.com.

2.07 ACCESSORIES

- A. Prefabricated Roofing Expansion Joint Flashing: As specified in Section 07 71 00.
- B. Cant and Edge Strips: Asphalt-impregnated wood fiberboard, compatible with roofing materials; cants formed to 45 degree angle.
- C. Pre-Cut Tapered Insulation:
- D. Sheathing Adhesive: Non-combustible type, for adhering gypsum sheathing to metal deck.
- E. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.
 - 1. Length as required for thickness of insulation material and penetration of deck substrate, with metal washers.
- F. Roofing Nails: Galvanized, hot dipped type, size and configuration as required to suit application.
- G. Strip Reglet Devices: Galvanized steel, maximum possible lengths per location, with attachment flanges.
- H. Sealants: As recommended by membrane manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and site conditions are ready to receive work.
- B. Verify deck is supported and secure.
- C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
- D. Verify deck surfaces are dry and free of snow or ice.
- E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.02 CONCRETE DECK PREPARATION

- A. Fill surface honeycomb and variations with latex filler.
- B. Confirm dry deck by moisture meter with 12 percent moisture maximum.

C. Conventional Application: Apply mopped two-ply vapor retarder.

3.03 INSULATION INSTALLATION

- A. Attachment of Insulation:
 - 1. Mechanically fasten first layer of insulation to deck in accordance with roofing manufacturer's instructions and Factory Mutual requirements.
- B. Lay subsequent layers of insulation with joints staggered minimum 6 inch from joints of preceding layer.
- C. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
- D. On metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes.
- E. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
- F. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 18 inches.
- G. Do not apply more insulation than can be covered with membrane in same day.

3.04 MEMBRANE APPLICATION

- A. Apply membrane in accordance with manufacturer's instructions.
- B. Apply membrane; lap and seal edges and ends permanently waterproof.
- C. Apply smooth, free from air pockets, wrinkles, fish-mouths, or tears. Ensure full bond of membrane to substrate.
- D. At end of day's operation, install waterproof cut-off. Remove cut-off before resuming roofing.
- E. At intersections with vertical surfaces:
 - 1. Extend membrane over cant strips and up a minimum of 8 inches onto vertical surfaces.
 - 2. Apply flexible flashing over membrane.
- F. Around roof penetrations, mop in and seal flanges and flashings with flexible flashing.
- G. Install roofing expansion joints. Make joints watertight.
 - 1. Install prefabricated joint components in accordance with manufacturer's instructions.
- H. Coordinate installation of roof drains and sumps and related flashings.

3.05 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field quality control and inspection.
- B. Require site attendance of roofing and insulation material manufacturers daily during installation of the Work.

3.06 CLEANING

- A. Remove bituminous markings from finished surfaces.

- B. In areas where finished surfaces are soiled by bitumen or other source of soiling caused by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.
- C. Repair or replace defaced or damaged finishes caused by work of this section.

3.07 PROTECTION

- A. Protect installed roofing and flashings from construction operations.
- B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fabricated sheet metal items, including flashings and counterflashings.
- B. Sealants for joints within sheet metal fabrications.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood nailers for sheet metal work.
- B. Section 07 72 00 - Roof Accessories: Manufactured metal roof curbs.
- C. Section 07 90 05 - Joint Sealers.
- D. Section 09 90 00 - Painting and Coating: Field painting.

1.03 REFERENCE STANDARDS

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.
- B. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2015.
- C. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2013.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- E. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).
- F. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- G. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.
- H. ASTM D4479/D4479M - Standard Specification for Asphalt Roof Coatings - Asbestos-Free; 2007 (Reapproved 2012).
- I. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2012).
- J. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.
- B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with 5 years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

- A. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage (0.0239 inch) thick base metal.
- B. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage (0.0239) inch thick base metal, shop pre-coated with PVDF coating.
 - 1. Acrylic Polyester Coating: Pigmented Organic Coating System, AAMA 2603; baked enamel finish system.
 - 2. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
 - 3. Color: As selected by Architect from manufacturer's standard colors.

2.02 ACCESSORIES

- A. Fasteners: Galvanized steel, with soft neoprene washers.
- B. Primer: Zinc chromate type.
- C. Protective Backing Paint: Zinc molybdate alkyd.
- D. Sealant to be Concealed in Completed Work: Non-curing butyl sealant.
- E. Sealant to be Exposed in Completed Work: ASTM C920; elastomeric sealant, 100 percent silicone with minimum movement capability of plus/minus 25 percent and recommended by manufacturer for substrates to be sealed; clear.
- F. Plastic Cement: ASTM D4586, Type I.
- G. Solder: ASTM B32; Sn50 (50/50) type.

2.03 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest possible lengths.
- C. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- D. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- E. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

- B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

3.03 INSTALLATION

- A. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted.
- B. Apply plastic cement compound between metal flashings and felt flashings.
- C. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- D. Solder metal joints for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.
- E. Secure gutters and downspouts in place using concealed fasteners.
- F. Slope gutters 1/4 inch per 10 feet, minimum.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for field inspection requirements.
- B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION

SECTION 07 71 00 - ROOF SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Roof expansion joint covers.
- B. Precast concrete splash pads.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels; 2013.
- B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- C. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.
- D. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels; 2013.
- E. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2012).
- F. NRCA ML104 - The NRCA Roofing and Waterproofing Manual; National Roofing Contractors Association; Fifth Edition, with interim updates.
- G. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.
- H. SPRI ES-1 - Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems; Single Ply Roofing Industry; 2011. (ANSI/SPRI/FM 4435/ES-1)

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.
- C. Samples: Submit two appropriately sized samples of coping and gravel stop.
- D. Manufacturer's Installation Instructions: Indicate special procedures, fasteners, supporting members, and perimeter conditions requiring special attention.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA (ASMM) details.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Control and Expansion Joint Covers:
 - 1. GAF; ____: www.gaf.com.
 - 2. Johns Manville; Product ____: www.jm.com.
 - 3. MM Systems Corp; ____: www.mmsystemscorp.com.

2.02 COMPONENTS

- A. Control and Expansion Joint Covers: Composite construction of 6 inch wide flexible EPDM flashing of white color with closed cell urethane foam backing, each edge seamed to aluminum sheet metal flanges, designed for nominal joint width of 2 inch. Include special formed corners, tees, intersections, and wall flashings, each sealed watertight.
- B. Pipe and Penetration Flashing: Base of rounded aluminum, compatible with sheet metal roof systems, and capable of accomodating pipes sized between 0.375 inches and 12 inches.
 - 1. Caps: EPDM.
- C. Splash Pads: Precast concrete type , of size and profiles indicated: minimum 3000 psi at 28 days, with a minimum 5% air entrainment.

2.03 ACCESSORIES

- A. Sealant for Joints in Linear Components: As recommended by component manufacturer.
- B. Adhesive for Anchoring to Roof Membrane: Compatible with roof membrane and approved by roof membrane manufacturer.

2.04 FINISHES

- A. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system; color as scheduled.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions.
- B. Seal joints within components when required by component manufacturer.
- C. Anchor components securely.
- D. Coordinate installation of components of this section with installation of roofing membrane and base flashings.
- E. Install gutters, downspouts, and accessories in accordance with manufacturer's instructions.
- F. Sheet Metal: Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts and accessories.
- G. PVC: Solvent-weld lengths and connection pieces to form watertight joints. Solvent-weld gutters to downspouts and accessories.
- H. Solder metal joints for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.
- I. Coordinate installation of sealants and roofing cement with work of this section to ensure water tightness.

J. Coordinate installation of flashing flanges into reglets .

END OF SECTION

SECTION 07 84 00 - FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Firestopping of all joints and penetrations in fire resistance rated assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 RELATED REQUIREMENTS

- A. Section 09 21 16 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

1.03 REFERENCE STANDARDS

- A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2015.
- B. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops; 2013a.
- C. ASTM E1966 - Standard Test Method for Fire Resistive Joint Systems; 2007 (Reapproved 2011).
- D. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies; 2013.
- E. ITS (DIR) - Directory of Listed Products; current edition.
- F. FA (AG) - FM Approval Guide; Factory Mutual Research Corporation; current edition.
- G. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.
- H. UL (FRD) - Fire Resistance Directory; current edition.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
- C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- D. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- E. Installer Qualification: Submit qualification statements for installing mechanics.

1.05 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
- B. Installer Qualifications: Company specializing in performing the work of this section and:

1.06 MOCK-UP

- A. Install one firestopping assembly representative of each fire rating design required on project.
 - 1. Where one design may be used for different penetrating items or in different wall constructions, install one assembly for each different combination.

2. Where firestopping is intended to fill a linear opening, install minimum of 1 linear ft.
- B. If accepted, mock-up will represent minimum standard for the Work.
- C. If accepted, mock-up may remain as part of the Work. Remove and replace mock-ups not accepted.

1.07 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for 3 days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.01 FIRESTOPPING - GENERAL REQUIREMENTS

- A. Manufacturers:
 1. 3M Fire Protection Products; _____: www.3m.com/firestop.
 2. Hilti, Inc: www.us.hilti.com/#sle.
- B. Firestopping: Any material meeting requirements.
- C. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.

2.02 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. Head-of-Wall Firestopping at Joints Between Non-Rated Floor and Fire-Rated Wall: Use any system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of floor or wall, whichever is greater.
- B. Floor-to-Floor, Wall-to-Wall, and Wall-to-Floor Joints, Except Perimeter, Where Both Are Fire-Rated: Use any system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
- C. Through Penetration Firestopping: Use any system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.

2.03 FIRESTOPPING FOR FLOOR-TO-FLOOR, WALL-TO-FLOOR, AND WALL-TO-WALL JOINTS

- A. Concrete and Concrete Masonry Walls and Floors:
 1. Top of Wall Joints at Concrete/Concrete Masonry Wall to Concrete Over Metal Deck Floor:

2.04 FIRESTOPPING PENETRATIONS THROUGH CONCRETE AND CONCRETE MASONRY CONSTRUCTION

- A. Penetrations Through Walls By:
 1. Uninsulated Metallic Pipe, Conduit, and Tubing:
 - a. 1 Hour Construction: UL System W-J-1067; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 2. Insulated Pipes:

- a. 1 Hour Construction: UL System C-AJ-5090; Hilti FS-ONE MAX Intumescent Firestop Sealant.
- b. 1 Hour Construction: UL System C-AJ-5091; Hilti FS-ONE MAX Intumescent Firestop Sealant.

2.05 FIRESTOPPING SYSTEMS

- A. Firestopping: Any material meeting requirements.
 - 1. Fire Ratings: Use any system that is listed by FM, ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814 or ASTM E119 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.

3.03 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

3.04 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.05 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 07 90 05 - JOINT SEALERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sealants and joint backing.
- B. Precompressed foam sealers.
- C. Hollow gaskets.

1.02 RELATED REQUIREMENTS

- A. Section 07 25 00 - Weather Barriers: Sealants required in conjunction with air barriers and vapor retarders:
- B. Section 08 80 00 - GLAZING: Glazing sealants and accessories.
- C. Section 09 21 16 - Gypsum Board Assemblies: Acoustic sealant.
- D. Section 09 30 00 - Tiling: Sealant used as tile grout.

1.03 REFERENCE STANDARDS

- A. ASTM C834 - Standard Specification for Latex Sealants; 2014.
- B. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2012.
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.
- D. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2013.
- E. ASTM D1056 - Standard Specification for Flexible Cellular Materials--Sponge or Expanded Rubber; 2014.
- F. ASTM D1667 - Standard Specification for Flexible Cellular Materials--Poly(Vinyl Chloride) Foam (Closed-Cell); 2005 (Reapproved 2011).
- G. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2005 (Reapproved 2010).
- H. ASTM D2628 - Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements; 1991 (Reapproved 2011).

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with other sections referencing this section.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.
- C. Manufacturer's Installation Instructions: Indicate special procedures, surface preparation, and perimeter conditions requiring special attention.

1.06 QUALITY ASSURANCE

- A. Maintain one copy of each referenced document covering installation requirements on site.

- B. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years documented experience and approved by manufacturer.

1.07 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Gunnable and Pourable Sealants:
 - 1. BASF Construction Chemicals-Building Systems: www.buildingsystems.basf.com.
 - 2. Bostik Inc: www.bostik-us.com.
 - 3. Dow Corning Corporation: www.dowcorning.com.
 - 4. Hilti, Inc: www.us.hilti.com.
 - 5. Pecora Corporation: www.pecora.com.
 - 6. Tremco Global Sealants: www.tremcosealants.com.
- B. Preformed Compressible Foam Sealers:
 - 1. EMSEAL Joint Systems, Ltd: www.emseal.com.
 - 2. Tremco Global Sealants: www.tremcosealants.com.

2.02 SEALANTS

- A. Sealants and Primers - General: Provide products having volatile organic compound (VOC) content as specified in Section 01 61 16.
- B. General Purpose Exterior Sealant: Polyurethane; ASTM C920, Grade NS, Class 25 minimum; Uses M, G, and A; single component.
 - 1. Color: To be selected by Architect from manufacturer's standard range.
 - 2. Applications: Use for:
 - a. Control, expansion, and soft joints in masonry.
 - b. Joints between concrete and other materials.
 - c. Joints between metal frames and other materials.
 - d. Other exterior joints for which no other sealant is indicated.
 - 3. Polyurethane Products:
 - a. Pecora Corporation; DynaTrol I-XL General Purpose One Part Polyurethane Sealant: www.pecora.com.
- C. Exterior Expansion Joint Sealer: Precompressed foam sealer; urethane with water-repellent;
 - 1. Size as required to provide weathertight seal when installed.
 - 2. Applications: Use for:
 - a. Exterior wall expansion joints.
 - 3. Products:
 - a. WillSeal Joint Systems,; 150 Series: www.willseal.com.

- D. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, Type OP, Grade NF single component, paintable.
 - 1. Color: To be selected by Architect from manufacturer's standard range.
 - 2. Applications: Use for:
 - a. Interior wall and ceiling control joints.
 - b. Joints between door and window frames and wall surfaces.
 - c. Other interior joints for which no other type of sealant is indicated.
- E. Bathtub/Tile Sealant: White silicone; ASTM C920, Uses I, M and A; single component, mildew resistant.
 - 1. Applications: Use for:
 - a. Joints between plumbing fixtures and floor and wall surfaces.
 - b. Joints between shower and bathtub countertops and wall surfaces.
- F. Acoustical Sealant for Concealed Locations:
 - 1. Composition: Acrylic latex emulsion sealant.
 - 2. Applications: Use for concealed locations only:
- G. Concrete Floor Joint Filler: Self-leveling, pourable, semi-rigid sealant intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
 - 1. Composition: , Single or multi-part, 100 percent solids by weight.
 - 2. Hardness: 85 after 7 days, when tested in accordance with ASTM D2240 Shore A.
 - 3. Color: Concrete gray.
 - 4. Joint Width: 1/8 inch.
- H. Concrete Paving Joint Sealant: Polyurethane, self-leveling; ASTM C920, Class 25, Uses T, I, M and A; single component.
 - 1. Color: Gray.
 - 2. Applications: Use for:
 - a. Joints in sidewalks and vehicular paving.

2.03 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.
- C. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, 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.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify that joint backing and release tapes are compatible with sealant.

3.02 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.

- B. Clean and prime joints in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Protect elements surrounding the work of this section from damage or disfigurement.
- E. Exposed Concrete Floor Joints: Test joint filler in inconspicuous area of floor slab. Verify specified product does not stain or discolor slab.

3.03 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Perform acoustical sealant application work in accordance with ASTM C919.
- D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- E. Install bond breaker where joint backing is not used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- G. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- H. Tool joints concave.
- I. Precompressed Foam Sealant: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.
- J. Concrete Floor Joint Filler: Install concrete floor joint filler per manufacturer's written instructions. After floor joint filler is fully cured, shave joint filler flush with top of concrete slab.

3.04 CLEANING

- A. Clean adjacent soiled surfaces.

3.05 PROTECTION

- A. Protect sealants until cured.

END OF SECTION

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated hollow metal doors and frames.
- B. Fire rated door frames
- C. Hollow metal frames for wood doors.
- D. Thermally insulated hollow metal doors with frames.
- E. FEMA rated steel doors and frames.
- F. Hollow metal borrowed lites glazing frames.

1.02 RELATED REQUIREMENTS

- A. Section 08 71 00 - Door Hardware.
- B. Section 08 80 00 - GLAZING: Glass for doors and borrowed lites.

1.03 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI/SDI A250.3 - Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames; 2007 (R2011).
- C. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.
- D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.
- E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2015.
- H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2014.
- I. ASTM F1450 - Standard Test Methods for Hollow Metal Swinging Door Assemblies for Detention and Correctional Facilities; 2012a.
- J. FBC TAS 201 - Impact Test Procedures; Testing Application Standard; 1994.
- K. FBC TAS 202 - Criteria for Testing Impact and Non-Impact Resistant Building Envelope Components Using Uniform Static Air Pressure; Testing Application Standard; 1994.
- L. FBC TAS 203 - Criteria for Testing Products Subject To Cyclic Wind Pressure Loading; Testing Application Standard; 1994.

- M. FEMA P-361 - Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms; 2015.
- N. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.
- O. NAAMM HMMA 805 - Recommended Selection and Usage Guide for Hollow Metal Doors and Frames; 2012.
- P. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; 2007.
- Q. NAAMM HMMA 860 - Guide Specifications for Hollow Metal Doors and Frames; 2013.
- R. NAAMM HMMA 862 - Guide Specifications for Commercial Security Hollow Metal Doors and Frames; 2013.
- S. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
- D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- E. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. FEMA 361 Design and Construction Guidance for Community Shelters.
- C. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document that prescribes installation requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hollow Metal Doors and Frames:
 1. Ceco Door, an Assa Abloy Group company; _____: www.assaabloydss.com.
 2. De La Fontaine Inc; Hollow Metal Door Model _____: www.delafontaine.com.

3. De La Fontaine Inc; Windstorm-Resistant Steel Door and Frame; door style ____: www.delafontaine.com.
4. De La Fontaine Inc; Hollow Metal Frame ____ Profile: www.delafontaine.com.
5. Republic Doors; ____: www.republicdoor.com.
6. Steelcraft, an Allegion brand; ____: www.allegion.com/us.
7. Technical Glass Products; SteelBuilt Window & Door Systems: www.tgpamerica.com.
8. Rocky Mountain Custom Hollow Metals.
9. Substitutions: See Section 01 60 00 - Product Requirements.

B. FEMA 361 Steel Doors and Frames for Shelters.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Manufacturers listed below produce either standard or custom hollow metal work unless otherwise indicated. Verify specific capabilities with individual manufacturers.
 - a. Ceco Door Products: an Assa Abloy Group company.
 - b. Curries Company: an Assa Abloy Group company.
 - c. Fleming Door Products Ltd: an Assa Abloy Group Company.

2.02 DESIGN CRITERIA

A. Requirements for Hollow Metal Doors and Frames:

1. Steel used for fabrication of doors and frames shall comply with one or more of the following requirements; Galvannealed steel conforming to ASTM A653/A653M, cold-rolled steel conforming to ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel conforming to ASTM A1011/A1011M, Commercial Steel (CS) Type B for each.
2. Accessibility: Comply with ICC A117.1 and ADA Standards.
3. Finish: Factory primed, for field finishing.

B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

A. Type ____, Exterior Doors: Thermally insulated.

1. Based on NAAMM HMMA Custom Guidelines:
 - a. Comply with guidelines of NAAMM HMMA 860 for Hollow Metal Doors and Frames.
 - b. Performance Level 1 - Light Duty, in accordance with NAAMM HMMA 805.
 - c. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
 - d. Door Face Metal Thickness: 20 gage, 0.032 inch, minimum.
2. Core Material: Manufacturers standard core material/construction and in compliance with requirements.
3. Door Thickness: 1-3/4 inch, nominal.
4. Weatherstripping: Refer to Section 08 71 00.
5. Door Finish: Factory finished.

B. Type ____, Interior Doors, Non-Fire Rated:

1. Based on NAAMM HMMA Custom Guidelines:
 - a. Comply with guidelines of NAAMM HMMA 860 for Hollow Metal Doors and Frames.
 - b. Performance Level 1 - Light Duty, in accordance with NAAMM HMMA 805.
 - c. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
 - d. Door Face Metal Thickness: 20 gage, 0.032 inch, minimum.
 2. Core Material: Manufacturers standard core material/construction and in compliance with requirements.
 3. Door Thickness: 1-3/4 inch, nominal.
 4. Door Finish: Factory finished.
- C. FEMA Rated Exterior and Interior Hollow Metal Doors:
1. Based on NAAMM HMMA Custom Guidelines:
 - a. Comply with guidelines of NAAMM HMMA 862 for Commercial Security Hollow Metal Doors and Frames.
 - 1) Security Rating Impact Testing: Comply with forced entry and static load impact testing for Class 1 in accordance with NAAMM HMMA 862 and ASTM F1450 requirements.
 - b. Performance Level 2 - Moderate Duty, in accordance with NAAMM HMMA 805.
 - c. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
 - d. Door Face Metal Thickness: 14 gage, 0.067 inch, minimum.
 2. Shelter entry doors and their frames shall resist the design wind pressures for components and cladding as described in Section 1 and the missile impact loads of Section 2 of the National Performance Criteria for Tornado Shelters Federal Emergency Management Agency Mitigation Directorate, latest edition. Only single opening and paired opening doors, and their frames that can resist calculated design wind pressure and laboratory tested missile impacts are acceptable.
 3. All doors shall have sufficient points of connection to their frame to resist design wind pressure and impact loads.
 4. A protective missile resistant barrier is permitted to protect the door opening. The door should then be designed to resist wind pressures. The size and number of shelter doors shall be determined in accordance with applicable fire safety and building codes. In the event the community where the shelter is to be located has not adopted current fire safety and building codes, the requirements of the most recent editions of a model fire safety and a building code shall be used.
 5. Sheets are to be made of commercial quality hot dipped zinc coated steel that complies with ASTM A924 A60. Door gauges subject to tested assemblies as recommended by door manufacturer.
 6. Vertical edges will join the face sheets by a continuous weld extending the full height of the door. Welds are to be ground and filled to make them invisible and provide a smooth flush surface.
 7. Hinge reinforcement to be not less than 7 gage (3/16") plate 1 1/4" x 9" prepared for a 4 1/2" x 4 1/2" x .180 hinges.
 8. Reinforce tops and bottoms of all doors with inverted continuous steel channels not less than 16 gage, extending the full width of the door and welded to the face sheet. Doors shall have a steel closure channel welded in place so the web of the channel is flush with the top of the face sheets of the door. Plastic fillers are NOT acceptable.

9. Door systems, both single doors and paired openings, shall be a tested assembly including door hardware and must comply with the FEMA 361 Design and Construction Guidance for Community Shelters and have available verifiable third party conformance test results.

2.04 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. General:
 1. Comply with the requirements of grade specified for corresponding door.
 - a. Frames for Wood Doors: Comply with frame requirements in accordance with ANSI/SDI A250.8 (SDI-100), Level 1, 18 gage, 0.042 inch, minimum thickness.
 2. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
- C. Exterior Door Frames: Knock-down type.
 1. Weatherstripping: Separate, see Section 08 71 00.
- D. Interior Door Frames, Non-Fire-Rated: Face welded type.
 1. Frame Finish: Factory finished.
- E. Interior Door Frames, Fire-Rated: Face welded type.
 1. Fire Rating: Same as door, labeled.
 2. Frame Finish: Factory finished.
- F. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.
- G. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.
- H. FEMA Rated Hollow Metal Frames:
 1. To be a 14-gauge hot dipped zinc coated steel that complies with ASTM designations A924 A60.
 2. All frames are to be assembled so that the face miter seam is "closed and tight". Weld the face seam, grind and dress the weld area smooth. Apply a zinc rich primer over the grinding area, and finish with a matching prime paint.
 3. Frame assembly for single doors and paired openings, shall be tested and must comply with the FEMA 361 Design and Construction Guidance for Community Shelters and have available verifiable third party conformance test results.

2.05 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.06 ACCESSORIES

- A. Glazing: As specified in Section 08 80 00, factory installed.
- B. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.
- C. Astragals for Double Doors: Specified in Section 08 71 00.
 1. Exterior Doors: Steel, Z-shaped.
 2. Fire-Rated Doors: Steel, shape as required for fire rating.

- D. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.
- E. Grout for Frames: Portland cement grout with maximum 4 inch slump for hand troweling; thinner pumpable grout is prohibited.
- F. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.
- G. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

2.07 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.
- B. Factory Finish: Complying with ANSI/SDI A250.3, manufacturer's standard coating.
- C. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- E. Coordinate installation of hardware.
- F. Coordinate installation of glazing.
- G. Coordinate installation of electrical connections to electrical hardware items.
- H. Touch up damaged factory finishes.

3.04 TOLERANCES

- A. Clearances Between Door and Frame: Comply with related requirements of specified door and frame standards or custom guidelines indicated.
- B. Maximum Diagonal Distortion: 1/16 in measured with straight edge, corner to corner.

3.05 ADJUSTING

- A. Adjust for smooth and balanced door movement.

3.06 SCHEDULE

END OF SECTION

SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flush laminate wood doors; flush and flush glazed configuration; fire rated and non-rated.

1.02 RELATED REQUIREMENTS

- A. Section 08 11 13 - Hollow Metal Doors and Frames.
- B. Section 08 71 00 - Door Hardware.
- C. Section 08 80 00 - GLAZING.

1.03 REFERENCE STANDARDS

- A. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
- B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- C. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- D. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.
- E. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
- D. Specimen warranty.
- E. Test Reports: Show compliance with specified requirements for the following:
- F. Samples: Submit two samples of door construction, 8"by 8" inch in size cut from top corner of door.
- G. Samples: Submit two samples of door veneer, 8" x 8" inch in size illustrating plastic laminate pattern and color.
- H. Manufacturer's Installation Instructions: Indicate special installation instructions.
- I. Warranty, executed in Owner's name.

1.05 QUALITY ASSURANCE

- A. Maintain one copy of the specified door quality standard on site for review during installation and finishing.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.
- C. Installed Fire Rated Door Assembly: Conform to NFPA 80 for fire rated class as indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging. Inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

1.07 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
- C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. High Pressure Decorative Laminate (HPDL) Faced Doors:
 1. VT Industries, Inc; ____: www.vtindustries.com.
 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 DOORS

- A. Doors: See drawings for locations and additional requirements.
 1. Quality Level: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS).
 2. High Pressure Decorative Laminate (HPDL) Faced Doors: 5-ply unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
 1. Provide solid core doors at each location.
 2. Fire Rated Doors: Tested to 20 minutes, 60 minutes, 90 minutes, and ratings as indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc. (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
 3. High pressure decorative laminate finish as indicated on drawings.
 4. Low pressure decorative laminate finish as indicated on drawings.

2.03 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.
- B. Fire Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

2.04 DOOR FACINGS

- A. High Pressure Decorative Laminate (HPDL) Facing for Fire Doors: NEMA LD 3, SGF; ____ color; textured, low gloss finish.
- B. High Pressure Decorative Laminate (HPDL) Facing for Non-Fire-Rated Doors: NEMA LD 3, HGS; ____ color; textured, low gloss finish.

2.05 ACCESSORIES

- A. Hollow Metal Door Frames: As specified in Section 08 1113.
- B. Glazed Openings:
 - 1. Heat-Strengthened and Fully Tempered Glass: ASTM C1048.
- C. Glazing: As specified in Section 08 80 00.
- D. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.
- E. Astragals for Non-Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge.
- F. Astragals for Fire Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge, specifically for double doors.

2.06 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- C. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- D. Provide edge clearances in accordance with the quality standard specified.

2.07 FACTORY FINISHING - WOOD VENEER DOORS

- A. Factory finish doors in accordance with approved sample.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that 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.

3.02 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
 - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Use machine tools to cut or drill for hardware.

- D. Coordinate installation of doors with installation of frames and hardware.
- E. Coordinate installation of glazing.

3.03 TOLERANCES

- A. Conform to specified quality standard for fit and clearance tolerances.
- B. Conform to specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

END OF SECTION

SECTION 08 43 13 - ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass.
- B. Sliding Transaction Windows at Holcomb Elem. School.

1.02 RELATED REQUIREMENTS

- A. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.
- B. Section 08 71 00 - Door Hardware: Hardware items other than specified in this section.
- C. Section 08 80 00 - GLAZING: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.
- B. AAMA 501.2 - Field Check of Metal Storefronts, Curtain Walls, and Sloped Glazing Systems for Water Leakage; 2009.
- C. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.
- D. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.
- E. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels; 2013.
- F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.
- H. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- I. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
- J. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.

1.05 QUALITY ASSURANCE

- A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed at the State in which the Project is located.

- B. Manufacturer and Installer Qualifications: Company specializing in manufacturing aluminum glazing systems with minimum three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.07 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING

- A. Center-Set Style, Thermally-Broken:
 - 1. Basis of Design: Manko 2450.
 - 2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.
- B. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:
 - 1. EFCO, a Pella Company: www.efcocorp.com.
 - 2. Trulite Glass and Aluminum Solutions, LLC: www.trulite.com.
 - 3. Kawneer Company, Inc..
- C. Substitution Procedures: See Section 01 60 00 - Product Requirements.
 - 1. For any product not identified as "Basis of Design", submit information as specified for substitutions.

2.02 STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 - 1. **Holcomb Elementary School** Finish Color: Dark bronze.
 - 2. **Wiley Elementary School** Finish Color: Hemlock Green.
 - 3. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 - 4. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 - 5. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
 - 6. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period

without causing detrimental effect to system components, anchorages, and other building elements.

7. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
8. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

B. Performance Requirements:

1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
 - a. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
2. Water Penetration Resistance: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8 psf.
3. Air Leakage: Maximum of 0.06 cu ft/min sq ft of wall area, when tested in accordance with ASTM E283 at 6.27 psf pressure differential across assembly.

2.03 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
 1. Framing members for interior applications need not be thermally broken.
 2. Glazing Stops: Flush.
- B. Sliding Service Window (for Reception #E124): Provide SWB141DU Vertical Sliding Service Window by C.R. Laurence Co, Inc., www.crlaurence.com.
 1. Glazing: Pre-Glazed (1/4" glass)
 2. Size: 3'-4" wide by 4'-4" tall.
 3. Mode of Operation: Manual opening/Self Closing
 4. Locking: Provide Security Lock.
 5. Color: Duranodic Bronze
- C. Sliding Service Window (for Reception #E124): Provide D1041DU Horizontal Sliding Service Window by C.R. Laurence Co, Inc., www.crlaurence.com.
 1. Glazing: Pre-Glazed (1/4" glass)
 2. Size: 6'-0" wide by 4'-0" tall.
 3. Mode of Operation: Manual opening/Self Closing
 4. Locking: Provide Security Lock.
 5. Color: Duranodic Bronze

2.04 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Fasteners: Stainless steel.
- C. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

2.05 FINISHES

- A. **Holcomb Elementary School:** Class I Color Anodized Finish: AAMA 611 AA-M12C22A42
Integrally colored anodic coating not less than 0.7 mils thick.

- B. **Wiley Elementary School:** High Performance Organic Coatings: AAMA 2604; multiple coats, thermally cured fluoropolymer system.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.02 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- I. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 1/16 inches per 10 ft, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for independent testing and inspection requirements. Inspection will monitor quality of installation and glazing.

3.05 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.06 PROTECTION

- A. Protect installed products from damage during subsequent construction.

END OF SECTION

SECTION 08 71 00 - DOOR HARDWARE

TO BE ISSUED BY ADDENDUM

SECTION 08 80 00 - GLAZING

.01 SUMMARY

- A. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- B. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

.02 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

1.01 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.
- C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F .
2. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

1.02 GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

1.03 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
 1. Sealing System: Dual seal.
 2. Spacer: Manufacturer's standard spacer material and construction.

1.04 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
 1. Neoprene complying with ASTM C 864.
 2. EPDM complying with ASTM C 864.
 3. Silicone complying with ASTM C 1115.
 4. Thermoplastic polyolefin rubber complying with ASTM C 1115.
- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene, EPDM silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.
- C. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure stops on opposite side of glazing applied by means of pressure-glazing

1.05 GLAZING SEALANTS

- A. General:
 1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 3. VOC Content: For sealants used inside of the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

- C. Glazing Sealant: Type required and recommended by manufacturer for Fire-Rated Glass Location.

1.06 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 - 1. AAMA 804.3 tape, recommended by manufacturer.
 - 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 - 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
 - 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 - 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

1.07 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- E. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- F. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

1.08 GLASS TYPES

- A. **Type 1:** Clear Tempered Plate Glass: Provide prime glass which has been heat treated to strengthen glass in bonding to not less than 4.5 times *annealed strength 1/4" thickness.
- B. **Type 2:** Clear Tempered Plate Glass: Provide prime glass which has been heat treated to strengthen glass in bonding to not less than 4.5 times *annealed strength 1/4" thickness with Safety and Security film as specified in Section 08 87 17.
- C. **Type 3:** 20 minutes - 3 Hr. Fire/Impact Safety-Rated Glass: Same as 3/16" thick firelite NT as manufactured by Technical Glass Products.
 - 1. Fire Protection Rated Glass Products:
 - a. Subject to compliance with requirements, available product that may be incorporated into the Work include, but are not limited to, the following:

- 1) Firelite NT
 - 2) Or approved equal.
- D. **Type 4:** 1" thick insulated unit composed of: Exterior:: ¼" Reflective Solarcool Bronze, #2 Surface: Tempered ½" Tri-Seal black air spacer, Interior: ¼" Soft Coat Low-E MC37#3 surface tempered

PART 3 EXECUTION

2.01 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Glazed Fire Rated Glass in accordance with manufacturers requirements and materials.
- C. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- D. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- E. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- F. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- G. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- H. Provide spacers for glass lites where length plus width is larger than 50 inches.
- I. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

2.02 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Apply heel bead of elastomeric sealant.
- F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

- G. Apply cap bead of elastomeric sealant over exposed edge of tape.

2.03 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

2.04 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

2.05 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION

SECTION 08 87 17 - SAFETY AND SECURITY GLAZING FILMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Glazing film applied to existing and new glazing assemblies.
- B. Glazing assemblies to receive film are indicated on Drawings.

1.02 RELATED REQUIREMENTS

- A. Section 08 43 13 - Aluminum Framed Storefront: storefront, doors, vent windows
- B. Section 08 4413 - Glazed Aluminum Curtain Walls
- C. Section 08 8000 - Glazing: New glazing to received film.

1.03 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test; 2010.
- C. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting; 2012.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Record of product certification for safety requirements.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Installation methods.
- C. Shop Drawings: Detailing installation of film, anchoring accessories, and sealant.
- D. Samples: For each film product to be used, minimum size 4 inches (102 mm) by 6 inches (152 mm), representing actual product, color, and patterns.
- E. Test Reports: Detailed reports of full-scale chamber tests to specified criteria, using assemblies identical to those required for this project.
- F. Specimen Warranty.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Glazing film manufacturer specializing in manufacture of safety glazing films with minimum 10 years successful experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of authorities having jurisdiction.

1.07 FIELD CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.08 WARRANTY

- A. Provide 10 year manufacturer's replacement warranty to cover film against peeling, cracking, discoloration, and deterioration.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. 3M Window Film: www.3m.com/us/arch_construct/scpd/windowfilm.
- B. Substitutions: See Section 01 6000 - Product Requirements.

2.02 SAFETY AND SECURITY GLAZING FILM

- A. Safety Glazing : Retrofit existing glazing assemblies to provide impact resistance complying with ANSI Z97.1 and CPSC 16 CFR 1201 Category II, as specified:
 - 1. Surface applied film.

2.03 MATERIALS

- A. At Holcomb Schools: 3M Scotchshield Safety and Security Window Film Ultra S800
 - 1. Thickness: 0.008 inch (0.2 mm), minimum.
 - 2. Color: Tinted.
 - 3. Construction: Multi-ply laminate.
 - 4. Adhesive Type: Pressure sensitive acrylic.
 - 5. Tensile Strength: 27,000 psi (186 MPa) minimum when tested in accordance with ASTM D882.
 - 6. Light Transmission of Flim Applied (applied to 1/4" glass)
 - a. Visible Light Transmittance: 87 percent.
 - b. UV blocked 99.9%
 - 7. Substitutions: Refer to Section 01 6000 - Product Requirements.
- B. Accessory Materials: As recommended or required by film manufacturer.
 - 1. Furnish and install manufacturer's recommended Impact Protection Attachment system.
 - a. 3M Impact Protection Profile system (IPP), or
 - b. 3M Impact Protection Adhesive system (IPA)
- C. Furnish with manufacturer's recommended primers and miscellaneous accessories as shown and/or specified, or as otherwise required for a complete working installation.
- D. Glass Cleaner: As recommended by glazing film manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine glass and frames. Verify that existing conditions are adequate for proper application and performance of film.

- B. Verify glass is not cracked, chipped, broken, or damaged.
- C. Verify that frames are securely anchored and free of defects.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean glass of dust, dirt, paint, oil, grease, mildew, mold, and other contaminants that would inhibit adhesion.
- B. Immediately prior to applying film, thoroughly wash glass with neutral cleaning solution.
- C. Protect adjacent surfaces.
- D. Do not begin installation until substrates have been properly prepared.

3.03 INSTALLATION

- A. Do not apply glazing film when surface temperature is less than 40 degrees F (4 degrees C) or if precipitation is imminent.
- B. Install in accordance with manufacturer's instructions, without air bubbles, wrinkles, streaks, bands, thin spots, pinholes, or gaps, as required to achieve specified performance.
- C. Accurately cut film with straight edges to required sizes allowing 1/16 inch (2 mm) to 1/8 inch (3 mm) gap at perimeter of glazed panel unless otherwise required by anchorage method.
- D. Seams: Seam film only as required to accommodate material sizes; form seams vertically without overlaps and gaps; do not install with horizontal seams.
- E. Clean glass and anchoring accessories following installation. Remove excess sealants and other glazing materials from adjacent finished surfaces.
- F. Remove labels and protective covers.
- G. Furnish and install manufacturer's recommended Impact Protection Attachment system.

3.04 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Metal stud wall framing.
- C. Metal channel ceiling framing.
- D. Gypsum wallboard.
- E. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.
- B. Section 07 92 00 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

1.03 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- B. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.
- C. ASTM C514 - Standard Specification for Nails for the Application of Gypsum Board; 2004 (Reapproved 2014).
- D. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003 (Reapproved 2009).
- E. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.
- F. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2015.
- G. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2013.
- H. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2015.
- I. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
- J. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.
- K. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.
- L. ASTM C1280 - Standard Specification for Application of Gypsum Sheathing Board; 2013.
- M. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014.
- N. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2012.

- O. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- P. GA-216 - Application and Finishing of Gypsum Board; 2013.
- Q. ICC (IBC) - International Building Code; 2015.
- R. UL (FRD) - Fire Resistance Directory; current edition.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.
- C. Test Reports: For stud framing products that do not comply with ASTM C645 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing gypsum board application and finishing, with minimum __ years of documented experience.

PART 2 PRODUCTS

2.01 GYPSON BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.

2.02 METAL FRAMING MATERIALS

- A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
 - 1. Studs: "C" shaped with flat or formed webs with knurled faces.
 - 2. Runners: U shaped, sized to match studs.
 - 3. Ceiling Channels: C-shaped.
 - 4. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
 - 5. Resilient Furring Channels: 1/2 inch depth, for attachment to substrate through one leg only.
- B. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.

2.03 BOARD MATERIALS

- A. Gypsum Wallboard: use Type "X" UL listed paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Application: Use for all vertical surfaces, unless otherwise indicated.
 - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - a. Mold-resistant board is required whenever board is being installed before the building is enclosed and conditioned.
 - b. Mold resistant board is required at all "wet" areas (ie" showers, janitor closets and all rooms scheduled for tile finishes,.
 - 3. Thickness:

- a. Vertical Surfaces: 5/8 inch.
- 4. Glass Mat Faced Products:
- B. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Application: Ceilings, unless otherwise indicated.
 - 2. Thickness: 5/8 inch.
 - 3. Edges: Tapered.
 - 4. Products:
 - a. Georgia-Pacific Gypsum; ToughRock Span 24 Ceiling Board.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 ACCESSORIES

- A. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
 - 1. Types: As detailed or required for finished appearance.
- B. Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic, galvanized steel, or rolled zinc, unless noted otherwise.
 - 1. Expansion Joints: V-shaped PVC with tear away fins.
- C. Joint Materials: ASTM C475 and as recommended by gypsum board manufacturer for project conditions.
 - 1. Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
 - 2. Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
 - 3. Ready-mixed vinyl-based joint compound.
- D. High Build Drywall Surfer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.
- E. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.
- F. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion resistant.
- G. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.
- H. Adhesive for Attachment to Metal:

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
- C. Blocking: Install wood blocking for support of:

1. Wall mounted cabinets.
2. Plumbing fixtures.
3. Toilet partitions.
4. Toilet accessories.
5. Wall mounted door hardware.

3.03 BOARD INSTALLATION

- A. Comply with ASTM C 840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
 1. Exception: Tapered edges to receive joint treatment at right angles to framing.
- C. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of non-rated double-layer assemblies, which may be installed by means of adhesive lamination.

3.04 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
 1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.05 JOINT TREATMENT

- A. Paper Faced Gypsum Board: Use paper joint tape, bedded with ready-mixed vinyl-based joint compound and finished with ready-mixed vinyl-based joint compound.
- B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
 2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
 3. Level 3: Walls to receive textured wall finish.
 4. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
 5. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 1. Feather coats of joint compound so that camber is maximum 1/32 inch.
 2. Taping, filling, and sanding is not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.
- D. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

3.06 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

SECTION 09 30 00 - TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tile for floor applications.
- B. Non-ceramic trim.

1.02 RELATED REQUIREMENTS

- A. Section 03 54 00 - Cast Underlayment.
- B. Section 07 92 00 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.
- C. Section 22 40 00 - Plumbing Fixtures

1.03 REFERENCE STANDARDS

- A. ANSI A108/A118/A136.1 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2013.1.
- B. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 1999 (Reaffirmed 2010).
- C. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2013.1.
- D. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
- E. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2011.
- F. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2015.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Tile: 3 percent of each size, color, and surface finish combination.

1.06 QUALITY ASSURANCE

- A. Maintain one copy of and ANSI A108/A118/A136.1 and TCNA (HB) on site.

- B. Installer Qualifications: Company specializing in performing tile installation, with minimum of five years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature of 50 degrees F during installation of mortar materials.

PART 2 PRODUCTS

2.01 TILE

- A. Manufacturers:
 - 1. Crossville Inc. www.crossville.com
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Porcelain Floor Tile Type PT-1:
 - 1. Color Blox manufactured by Crossville or approved equivalent product.
 - 2. Size and Shape: 12"x12".
 - 3. Edges: Square.
 - 4. Surface Finish: Textured
 - 5. Color: A1108 Sea Otter; Price Group I
 - 6. Pattern: Running Bond .

2.02 TRIM AND ACCESSORIES

- A. Non-Ceramic Trim: Satin natural anodized extruded aluminum, style and dimensions to suit application, for setting using tile mortar or adhesive.
 - 1. Applications:
 - a. Open edges of wall tile.
 - b. Open edges of floor tile.
 - c. Wall corners, outside and inside.
 - d. Transition between floor finishes of different heights.
 - 2. Manufacturers:
 - a. Schluter-Systems: www.schluter.com.

2.03 SETTING MATERIALS

- A. Provide setting materials made by the same manufacturer as grout.
- B. Latex Modified Thin Set Mortar: ANSI A118.4 and ISO 13007 C2.
 - 1. Applications: Use this type of bond coat where indicated and where no other type of bond coat is indicated.
 - 2. Products:
 - a. ARDEX Engineered Cements; _____: www.ardexamericas.com.
 - b. AVM Industries, Inc; Thin-Set 780: www.avmindustries.com.
 - c. LATICRETE International, Inc; _____: www.laticrete.com.
 - d. Merkrete, by Parex USA, Inc; _____: www.merkrete.com.

- e. TEC Specialties; www.tecspecialties.com Perma Flex 300.
- f. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 GROUTS

- A. Manufacturers:
 - 1. TEC Specialties; www.tecspecialties.com _____.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Polymer Modified Grout: ANSI A118.7 polymer modified cement grout.
 - 1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
 - 2. Use sanded grout for joints 1/8 inch wide and larger; use unsanded grout for joints less than 1/8 inch wide.
 - 3. Color(s): As selected by Architect from manufacturer's full line.
 - 4. Products:
 - a. TEC Specialties; Power Grout www.tecspecialties.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.05 ACCESSORY MATERIALS

- A. Liquid Applied Waterproofing Membrane at Floors: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
 - 1. Fluid Applied Type:
 - a. Material: Synthetic rubber or Acrylic.
 - b. Products:
 - 1) H.B. Fuller Construction Products Inc; TEC HydraFlex Waterproofing Crack Isolation Membrane: www.tecspecialty.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.
- D. Verify that concrete sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within the following limits:
 - 1. Moisture Emission Rate: Not greater than 3 lb per 1000 sq ft per 24 hours, test in accordance with ASTM F1869.
 - 2. Alkalinity (pH): Verify pH range of 5 to 9, test in accordance with ASTM F710.
 - 3. Obtain instructions if test results are not within limits recommended by tile flooring manufacturer and setting materials manufacturer.

3.02 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. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.03 INSTALLATION - GENERAL

- A. Install tile and grout in accordance with applicable requirements of ANSI A108.1a thru A108.13, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles square and external angles bullnosed.
- F. Install non-ceramic trim in accordance with manufacturer's instructions.
- G. Sound tile after setting. Replace hollow sounding units.
- H. Keep control and expansion joints free of mortar, grout, and adhesive.
- I. Keep expansion joints free of adhesive or grout. Apply sealant to joints.
- J. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- K. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.
- L. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.04 INSTALLATION - FLOORS - THIN-SET METHODS

- A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with standard grout, unless otherwise indicated.
 - 1. Where waterproofing membrane is indicated, install in accordance with TCNA (HB) Method F122, with latex-Portland cement grout.
 - 2. Where epoxy bond coat and grout are indicated, install in accordance with TCNA (HB) Method F131.

3.05 CLEANING

- A. Clean tile and grout surfaces.

3.06 PROTECTION

- A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

SECTION 09 51 00 - SUSPENDED ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.
- C. Ceiling Sound Diffusers MS-03

1.02 RELATED REQUIREMENTS

- A. Section 23 37 00 - Air Outlets and Inlets: Air diffusion devices in ceiling.
- B. Section 26 51 00 - Interior Lighting: Light fixtures in ceiling system.

1.03 REFERENCE STANDARDS

- A. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2013a.
- B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2013.
- C. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2014.
- D. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical 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.
- B. Do not install acoustical units until after interior wet work is dry.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on suspension system components.
- C. Samples: Submit two samples ____ by ____ inch in size illustrating material and finish of acoustical units.
- D. Manufacturer's Installation Instructions: Indicate special procedures.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Acoustical Units: Quantity equal to 3 percent of total installed.

1.06 QUALITY ASSURANCE

- A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acoustic Panels:
 - 1. Armstrong World Industries, Inc; ____: www.armstrong.com.
- B. Suspension Systems:
 - 1. Same as for acoustical units.
 - 2. Armstrong World Industries, Inc; ____: www.armstrong.com.
- C. Ceiling Sound Diffusers:
 - 1. G&S Acoustics www.gsacoustics.com

2.02 ACOUSTICAL UNITS

- A. Acoustical Units - General: ASTM E1264, Class A.
- B. Acoustical Tile Type AGC1: Painted mineral fiber, ASTM E1264 Type III, with the following characteristics:
 - 1. Size: 24 by 48 inches.
 - 2. Thickness: 5/8" inches.
 - 3. Composition: Wet-formed mineral fiber.
 - 4. Light Reflectance: .83 percent, determined in accordance with ASTM E1264.
 - 5. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
 - 6. Edge: Square.
 - 7. Surface Color: White.
 - 8. Products:
 - a. Armstrong; Cortega No. 769.

2.03 SUSPENSION SYSTEM(S)

- A. Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.
- B. Exposed Steel Suspension System Type SS-1: Formed steel, commercial quality cold rolled; heavy-duty.
 - 1. Profile: Tee; 15/16 inch wide face.
 - 2. Construction: Double web.
 - 3. Finish: White painted.
 - 4. Products:
 - a. Armstrong; Prelude.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 CEILING SOUND DIFFUSERS MS-03

- A. Provide and install Ceiling Sound Diffusers as manufactured by G&S Acoustics www.gsacoustics.com or approved equal.

- B. Core: CD 0.125 Thermoformed co-polymer (recyclable), NRC = .10
- C. Shape: Pyramid (PCD)
- D. Size: 48 in. x 48 in.
- E. Mounting: Lay-in ceiling grid system
- F. Finish: Textured White
- G. Flammability: All components have a Class A rating per ASTM E84
- H. Installation: Each 4'x4' diffuser tile should be rotated 90 degrees sequentially, so they are not all facing a uniform direction.

2.05 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Perimeter Moldings: Same material and finish as grid.
 - 1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.
- C. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
- D. 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.
- E. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- F. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- G. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- H. Do not eccentrically load system or induce rotation of runners.
- I. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 - 1. Use longest practical lengths.

2. Overlap and rivet corners.

3.03 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install units after above-ceiling work is complete.
- E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting Acoustical Units:
 1. Make field cut edges of same profile as factory edges.
- G. Install hold-down clips on panels within 20 ft of an exterior door.

3.04 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

SECTION 09 65 00 - RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Resilient tile flooring.
- B. Resilient base.
- C. Installation accessories.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.

1.03 REFERENCE STANDARDS

- A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
- B. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2004 (Reapproved 2014).
- C. ASTM F1861 - Standard Specification for Resilient Wall Base; 2008 (Reapproved 2012).

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Verification Samples: Submit two samples, 3" x 3" inch in size illustrating color and pattern for each resilient flooring product specified.
- D. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of sub-floor is acceptable.
- E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Flooring & Wall Base Material: 3 % square feet of each type and color.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store all materials off of the floor in an acclimatized, weather-tight space.
- B. Protect roll materials from damage by storing on end.

1.06 FIELD CONDITIONS

- A. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- B. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.01 TILE FLOORING

- A. Vinyl Composition Tile: Homogeneous, with color extending throughout thickness.
 - 1. Manufacturers:
 - a. Armstrong World Industries, Inc; _____: www.armstrong.com.
 - b. Johnsonite, a Tarkett Company; _____: www.johnsonite.com.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Minimum Requirements: Comply with ASTM F1066, of Class corresponding to type specified.
 - 3. Size: 12 by 12 inch.
 - 4. Thickness: 0.125 inch.
 - 5. Pattern: Azrock VCT.
 - 6. Color: V-210 Oats.
 - 7. Manufacturers:
 - a. Johnsonite, a Tarkett Company; Product Azrock Collection: www.johnsonite.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 RESILIENT BASE

- A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.
 - 1. Manufacturers:
 - a. Johnsonite, a Tarkett Company; Traditional Wall Base: www.johnsonite.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Height: 4 inch.
 - 3. Thickness: 0.125 inch thick.
 - 4. Finish: Satin.
 - 5. Length: Roll.
 - 6. Color #1 (Wiley Elementary): 80 Fawn.
 - 7. Color #2 (Holcomb Elementary): 29 Moon Rock

2.03 ACCESSORIES

- A. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
- B. Moldings, Transition and Edge Strips: Same material as flooring.
 - 1. Manufacturers:
 - a. Johnsonite, a Tarkett Company; www.johnsonite.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

- C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.
 - 1. Test in accordance with ASTM F710.
 - 2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

3.02 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Clean substrate.

3.03 INSTALLATION

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Spread only enough adhesive to permit installation of materials before initial set.
- D. Fit joints and butt seams tightly.
- E. Set flooring in place, press with heavy roller to attain full adhesion.
- F. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- G. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
- H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.04 INSTALLATION - TILE FLOORING

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.
- B. Lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.

3.05 RESILIENT BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold. At exposed ends, use premolded units.
- C. Install base on solid backing. Bond tightly to wall and floor surfaces.
- D. Scribe and fit to door frames and other interruptions.

3.06 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

3.07 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

SECTION 09 68 13 - TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Carpet tile, fully adhered.
- B. Removal of existing carpet tile.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.

1.03 REFERENCE STANDARDS

- A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
- B. CRI (CIS) - Carpet Installation Standard; Carpet and Rug Institute; 2011.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- C. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
- D. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

1.06 FIELD CONDITIONS

- A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Carpet Tile, Type CPT-1(Wiley Elementary): Tufted, manufactured in one color dye lot.
 - 1. Product: Mache Modular 7608 manufactured by J&J Commercial.
 - 2. Tile Size: 24 by 24 inch, nominal.
 - 3. Color: Litho 438.
 - 4. Installation: Ashlar.

5. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
 6. Maximum Electrostatic Charge: 3 Kv. at 20 percent relative humidity.
 7. Gage: 1/12 inch.
 8. Secondary Backing Material: eko Modular.
- B. Carpet Tile Type CPT2(Holcomb Elementary): Tufted, manufactured in one color dye lot.
1. Product: Non-Fiction Modular 7026 manufactured by J&J Commercial.
 2. Tile Size: 24"x24" inch, nominal.
 3. Color: Cliff Hanger 1780.
 4. Installation: Ashlar.
 5. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
 6. Max. Electrostatic Charge: 3 Kv. at 20 percent relative humidity.
 7. Gage: 1/12 inch.
 8. Stitches: 10.00 per inch.
 9. Pile Weight: 5925 oz/sq yd.
 10. Primary Backing Material: Nexus Modular.
 11. Face Weight: 19 oz/sq yd.
- C. Carpet Tile Type CPT3(Both Schools): Tufted, manufactured in one color dye lot.
1. Product: Ruffian II manufactured by Mannington Commercial.
 2. Tile Size: 24"x24" inch, nominal.
 3. Color: Tan Tetons 8404.
 4. Installation: Quarter Turn.
 5. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
 6. Max. Electrostatic Charge: 3 Kv. at 20 percent relative humidity.
 7. Gage: 5/32 inch.
 8. Stitches: 9 per inch.
 9. Finished Yarn Weight: 38 oz/sq yd.
 10. Primary Backing Material: 100% Synthetic.
 11. Secondary Backing Material: Infinity RE Modular Reinforced Composite Closed Cell Polymer with Recycled content.

2.02 ACCESSORIES

- A. Sub-Floor Filler: White premix latex; type recommended by flooring material manufacturer.
- B. Edge Strips: Vinyl, _____ color
- C. Provide transition/reducing strips tapered to meet abutting materials as indicated in the drawings.
- D. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; Pressure Sensitive type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
- B. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-floor surfaces.

- C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for flooring installation by testing for moisture and pH.
 - 1. Test in accordance with ASTM F710.
 - 2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

3.02 PREPARATION

- A. Remove existing carpet tile.
- B. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- C. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.
- D. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
- E. Vacuum clean substrate.

3.03 INSTALLATION

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install carpet tile in accordance with manufacturer's instructions.
- C. Blend carpet from different cartons to ensure minimal variation in color match.
- D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.
- F. Fully adhere carpet tile to substrate.
- G. Trim carpet tile neatly at walls and around interruptions.
- H. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 09 90 00 - PAINTING AND COATING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints and other coatings.
- C. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
 - 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
 - 2. Exposed surfaces of steel lintels and ledge angles.
 - 3. Mechanical and Electrical:
 - a. In finished areas, paint all insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
- D. Do Not Paint or Finish the Following Items:
 - 1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - 5. Floors, unless specifically so indicated.
 - 6. Glass.
 - 7. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

- A. Section 05 50 00 - Metal Fabrications: Shop-primed items.

1.03 DEFINITIONS

- A. Conform to ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2014.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of all products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).

3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
- C. Manufacturer's Instructions: Indicate special surface preparation procedures.
- D. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and coated surfaces, and color samples of each color and finish used.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 2. Extra Paint and Coatings: 1 gallon of each color; store where directed.
 3. Label each container with color in addition to the manufacturer's label.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum five years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.08 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- D. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- E. Minimum Application Temperature for Varnish Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.
- F. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.
- B. Provide all paint and coating products from the same manufacturer to the greatest extent possible.

1. In the event that a single manufacturer cannot provide all specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
- C. Paints:
1. Benjamin Moore & Co: www.benjaminmoore.com.
 2. Sherwin-Williams Company: www.sherwin-williams.com.
- D. Primer Sealers: Same manufacturer as top coats.
- E. Block Fillers: Same manufacturer as top coats.
- F. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PAINTS AND COATINGS - GENERAL

- A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.
 2. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 3. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
 4. Supply each coating material in quantity required to complete entire project's work from a single production run.
 5. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.
- B. Primers: As follows unless other primer is required or recommended by manufacturer of top coats; where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.
1. Gypsum Board: Interior Latex Primer Sealer; MPI #50.
 2. Concrete: Interior Institutional Low Odor/VOC Primer Sealer; MPI #149.
 3. Concrete Masonry: Interior/Exterior Latex Block Filler; MPI #4.
 4. Steel, Uncoated: Anti-Corrosive Alkyd Primer for Metal; MPI #79.
 5. Steel -- Shop Primer: Interior/Exterior Quick Dry Alkyd Primer for Metal; MPI #76.
 6. Galvanized Steel: Interior Water Based Galvanized Primer; MPI #134.
- C. Volatile Organic Compound (VOC) Content:
1. Provide coatings that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- D. Flammability: Comply with applicable code for surface burning characteristics.
- E. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

- F. Colors: As indicated on drawings
 - 1. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.
 - 2. In utility areas, finish equipment, piping, conduit, and exposed duct work in colors according to the color coding scheme indicated.

2.03 PAINT SYSTEMS - EXTERIOR

- A. Paint E-OP - All Exterior Surfaces Indicated to be Painted, Unless Otherwise Indicated: Including primed metal.
 - 1. Preparation as specified by manufacturer.
 - 2. Two top coats and one coat primer recommended by manufacturer.
 - 3. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.
- B. Paint ME-OP-3A - Ferrous Metals, Unprimed, Alkyd, 3 Coat:
 - 1. One coat of alkyd primer.
 - 2. Semi-gloss: Two coats of alkyd enamel; ____.
- C. Paint ME-OP-2A - Ferrous Metals, Primed, Alkyd, 2 Coat:
 - 1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.
 - 2. Semi-gloss: Two coats of alkyd enamel; ____.
- D. Paint MgE-OP-3A - Galvanized Metals, Alkyd, 3 Coat:
 - 1. One coat galvanize primer.
 - 2. Semi-gloss: Two coats of alkyd enamel; ____.

2.04 PAINT SYSTEMS - INTERIOR

- A. Paint I-OP - All Interior Surfaces Indicated to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, concrete masonry, brick, uncoated steel, shop primed steel, and galvanized steel.
 - 1. Two top coats and one coat primer.
 - 2. Top Coat(s): Institutional Low Odor/VOC Interior Latex; MPI #143-148.
 - 3. Flat: MPI gloss level 1; use this sheen for ceilings and other overhead surfaces.
 - 4. Eggshell: MPI gloss level 3; use this sheen at all locations.
 - 5. Satin: MPI gloss level 4; use this sheen for items subject to frequent touching by occupants, including door frames and railings.
 - 6. Primer(s): As recommended by manufacturer of top coats.
- B. Paint I-OP-MD-WC - Medium Duty Vertical/Overhead: Including gypsum board, concrete masonry, uncoated steel, shop primed steel, and galvanized steel.
 - 1. Two top coats and one coat primer.
 - 2. Top Coat(s): Institutional Low Odor/VOC Interior Latex; MPI #143-148.
 - 3. Flat: MPI gloss level 1; use this sheen for ceilings and other overhead surfaces.
 - 4. Eggshell: MPI gloss level 3; use this sheen at all locations other than those listed above..
 - 5. Primer(s): As recommended by manufacturer of top coats.
- C. Paint I-OP-DF - Dry Fall: Metals; exposed structure and overhead-mounted services in utilitarian spaces, including shop primed steel deck, structural steel, metal fabrications, galvanized ducts, galvanized conduit, and galvanized piping.
 - 1. Shop primer by others.
 - 2. One top coat; white.
 - 3. Top Coat: Alkyd Dry Fall; MPI #55, 89, 225.

4. Eggshell: MPI gloss level 3; use this sheen at all locations.

2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin application of coatings until substrates have been properly prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- E. Test shop-applied primer for compatibility with subsequent cover materials.
- F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 1. Gypsum Wallboard: 12 percent.
 2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to coating application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or repair existing coatings that exhibit surface defects.
- D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- E. Seal surfaces that might cause bleed through or staining of topcoat.
- F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- G. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- H. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.
- I. Asphalt, Creosote, or Bituminous Surfaces to be Painted: Remove foreign particles to permit adhesion of finishing materials. Apply latex based sealer or primer.

- J. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- K. Corroded Steel and Iron Surfaces to be Painted: Prepare using at least SSPC-SP 2 (hand tool cleaning) or SSPC-SP 3 (power tool cleaning) followed by SSPC-SP 1 (solvent cleaning).
- L. Uncorroded Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand or power tool wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.
- M. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
- N. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's instructions.
- C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- E. Apply each coat to uniform appearance.
- F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.
- G. Sand metal surfaces lightly between coats to achieve required finish.
- H. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- I. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection.

3.05 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 PROTECTION

- A. Protect finished coatings until completion of project.
- B. Touch-up damaged coatings after Substantial Completion.

END OF SECTION

SECTION 10 1000 - MISCELLANEOUS SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY:

- A. Work included in this Section: Provision of miscellaneous specialty items including backing, attachment or other work required for installation unless specifically noted otherwise: Items include, but are not necessarily limited to the following:

M.S. – 01	Marker Boards
M.S. – 02	Acoustical Wall Panels
M.S. – 03	Acoustical Ceiling Pyramid
M.S. – 04	Projection Screens
M.S. – 05	Projector Mounts
M.S. – 06	Ceiling Expansion Joint Cover
M.S. – 07	Wall Expansion Joint Cover (Interior and Exterior)
M.S. – 08	Wall Expansion Joint Cover (Exterior)

- B. Related Work Included in other Sections:

1. Backing as Required.

- C. Alternates: Verify whether Alternate Bids affect work of this section.

1.2 SUBMITTALS:

- A. Manufacturer's literature describing products.
- B. Shop Drawings: Show locations and methods of attachment.
- C. Samples: As requested by the Architect.

1.3 PRODUCTS DELIVERY, STORAGE AND HANDLING:

- A. Deliver and store packaged products in original containers with seals unbroken and labels intact until time of use.
- B. Provide proper facilities for handling and storage of products to prevent damage. Where necessary, stack products off ground on level platform, fully protected from weather.

1.4 JOB CONDITIONS:

- A. Scheduling, Sequencing: Schedule installation of items to occur after application of exposed finishes wherever installation will not damage exposed finish surfaces and completion of finishes will not impede installation.

PART 2 - PRODUCTS

M.S. 01 –MARKERBOARDS

- A. Same as Mooreco Types “C”, “E” & “F” combo markerboards with 5/8” satin anodized aluminum mitered frame or approved equal. Markerboard shall be LCS #75 Low Gloss White 24 gauge liquid chalk surface on tempered hardboard with aluminum foil backing. Provide with continuous chalk trough and continuous 1’-0”

high tackboard with fabricork insert. Provide manufacturer's No. 16A adhesive and clip holders as recommended by the manufacturer for the specified size surface.

B. M.S. Number and sizes are as follows:

1. M.S. – 01: 48" High x 192" long, with 48" x 48" tackboard on each side

M.S. 02 – ACOUSTICAL WALL PANELS

A. Basis-of-Design Manufacturer: Provide products specified by Golterman & Sabo; 3555 Scarlet Oak Blvd., St. Louis, MO 63122; telephone 636-225-8800 or 800-737-0307; fax 636-225-2966; email – inquiry@golterman.com website www.golterman.com or comparable products by one of the following:

1. Acoustical Resources, Inc.
2. Koroseal Interior Products Group
3. RPG Diffusor Systems
4. Wenger Corporation

B. **MS – 2A:** Wall Diffuser Panels: Barrel-shaped units with properties as follows:

1. WD – Standard: Glass fiber mat core laminated with fire retardant resin: NRC 0.20.
2. Orientation: As indicated on drawings
3. Size: 24" wide by 48" tall
4. Mounting: Mechanical Clips
5. Fabric Finish:

a. Manufacturer: Design Tex:

1. Pattern: Architect to choose from standard pattern choices.
2. Color: Architect to choose from standard colors.

C. **MS – 2B:** Wall Diffuser Panels: Barrel-shaped units with properties as follows:

1. WD – Standard: Glass fiber mat core laminated with fire retardant resin: NRC 0.20.
2. Orientation: As indicated on drawings
3. Size: 48" wide by 48" tall
4. Mounting: Mechanical Clips
5. Fabric Finish:

b. Manufacturer: Design Tex:

3. Pattern: Architect to choose from standard pattern choices.
4. Color: Architect to choose from standard colors.

M.S. 03 – ACOUSTICAL CEILING PYRAMID DIFFUSERS

D. See section 095100 Suspended Acoustical Ceilings

M.S. 04 – PROJECTOR SCREEN

- A. Contractor shall furnish and install 8' W x 10'H projection screen "Tensioned Advantage Delux Electrol" as manufactured by DA-LITE. or approved equal.
- B. Projection screen to be electrically operated 120V (60 Hz). To have preset but adjustable limit switches to automatically stop screen fabric in the up and down positions. Stop action to be positive to prevent coasting. Roller to be mounted on two heavy-duty brackets equipped with self-aligning bearings. Screen surface to be flame retardant and mildew resistant, Matte White, with black basking borders standard. Motor compartment to be metal lined. Case to be finished with a primer coat, ready to accept final finish by others. Heavy metal brackets shall be supplied for mounting screen to ceiling. To be complete with three-position control switch in box with cover plate. Operate speed at 38' per minute.
- C. Install in strict accordance with manufacturers recommendations. Provide all necessary accessories to secure the screen in place

M.S. 05 – PROJECTOR MOUNTS

- A. Provide Pro Universal Projector Mount by Global Industrial, Inc. www.globalindustrial.com. 1-888-978-7759.
- B. Mount shall be adjustable with a range of 12.8" – 17.3".
- C. Stock #. WBB362934.
- D. Mount to existing structure as required.

M.S. 06–08 EXPANSION JOINT COVERS

- A. Furnish and install, as indicated on drawings, interior expansion joints as manufactured by Construction Specialties or by Balco, Inc., 2626 South Sheridan, Wichita, Kansas or approved equal.
- B. Expansion joint systems shall permit free movement of the joint for plus or minus 35% of the joint width. All corners, cross-connections, curbs, tee joints or other special accessories shall be shop fabricated and bonded to meet specific conditions.
- C. Butt joints within continuing runs shall be a maximum of 20'-0" apart and must be sealed during installation in accordance with manufacturers butt sealing recommendations.
- D. Flush Mounted Wall Joint Covers: Wall joint covers shall be flush or surface-mounted system, is designed to be dimensionally compatible with adjoining floor or ceiling joint covers.
- E. All assemblies shall be anchored to the structure 24" (0.6 mm) o.c. with appropriate anchorage, as recommended by the manufacturer.
- F. Elastomer Color: As selected by Architect.
- G. Expansion Joint Types:
 - M.S. – 06: FCF-200 Acoustical Ceiling System
 - M.S. – 07: ASM-200 Snap-On Wall (Interior & Exterior)
 - M.S. – 08: ASMC-200 Snap-On-Wall Corner (Exterior)

PART 3 - EXECUTION

3.1 PREPARATION:

- A. Coordinate details with other work supporting, adjoining, or otherwise contacting items as required to insure proper installation.

- 1. Insure adequate support will be available at time of installation.

3.2 INSPECTION:

- A. Examine construction to support, adjoin or otherwise contact and verify the following:

- 1. That dimensions are correct.
 - 2. That load-bearing studs are available where required by weight of items.
 - 3. That backing is installed and is otherwise adequate.
 - 4. That setting conditions are dry, clean and otherwise proper for installation.

- B. Do not install items until unsatisfactory conditions have been corrected.

3.3 INSTALLATION:

- A. General Requirements:

- 1. Install items in accordance with approved manufacturer's recommendations and review shop drawings.
 - 2. Employ mechanics skilled in installations required.
 - 3. Typical Fastenings: Use expansion bolts in masonry or concrete and machine screws or bolts to metal backing. Toggle bolts will not be permitted. Use fasteners with Torx-pin heads where fasteners are exposed in patient areas.

- B. Install platform lift in accordance with applicable regulatory requirements including ASME A 17.1, ASME A 18.1 and the manufacturer's instructions.

END OF SECTION 10 1000

SECTION 10 14 00 - SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Interior Room Signs
- B. Exterior Door Number Signs.

1.02 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- C. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.
- D. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
- E. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Exterior Door Number Signs - Graphic Blast Bordered Series as manufactured by Best Sign Systems, Inc. www.bestsigs.com or approved equal.

2.02 EXTERIOR DOOR NUMBER SIGN TYPES

- A. Construction:
 - 1. Sign material shall consist of figerglass, approximately 1/8" thick, with background painted a contrasting color.
 - 2. Lettering style shall be Helvetica Regular, upper case.
 - 3. Lettering for room usage and directional identification shall be 5/8" high.
 - 4. Letters and numbers shall be centered on sign.
 - 5. 1/2" Radius Corners.
- B. Standard Mounting Systems: Holes and screws.

2.03 ACCESSORIES

- A. Exposed Screws: Chrome plated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Locate signs where indicated:
 - 1. If no location is indicated obtain Owner's instructions.
- D. Protect from damage until Substantial Completion; repair or replace damage items.

3.03 INTERIOR SIGN SCHEDULE

A.	<u>Location</u>	<u>Size</u>	<u>Message</u>	<u>Special Instructions</u>
1.	101	7"x9"	Tornado Shelter	Mount at Door #A102A w/ Tornado pictogram.

3.04 EXTERIOR SIGN SCHEDULE

A.	<u>Location</u>	<u>Size</u>	<u>Message</u>	<u>Special Instructions</u>
1.	A102	6"x5"	4A	Mount above Door #A102B

END OF SECTION

SECTION 12 36 00 - COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Countertops for architectural cabinetwork.

1.02 RELATED REQUIREMENTS

- A. Section 06 41 00 - Architectural Wood Casework.
- B. Section 22 40 00 - Plumbing Fixtures: Sinks.

1.03 REFERENCE STANDARDS

- A. ANSI A161.2 - Performance Standards for Fabricated High Pressure Decorative Countertops; 1998.
- B. ANSI A208.2 - American National Standard for Medium Density Fiberboard for Interior Use; 2009.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- D. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- E. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Specimen warranty.
- C. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.
- D. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
- E. Installation Instructions: Manufacturer's installation instructions and recommendations.
- F. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: Same fabricator as for cabinets on which tops are to be installed.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 COUNTERTOP ASSEMBLIES

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS).
- B. Plastic Laminate Countertops: High pressure decorative laminate sheet bonded to substrate.
 - 1. Laminate Sheet, Unless Otherwise Indicated: NEMA LD 3, Grade HGS, 0.048 inch nominal thickness.
 - a. Surface Burning Characteristics: Flame spread 25, maximum; smoke developed 450, maximum; when tested in accordance with ASTM E84.
 - b. Finish: Matte or suede, gloss rating of 5 to 20.
 - c. Surface Color and Pattern: As selected by Architect from the manufacturer's full line.
 - d. Manufacturers:
 - 1) Formica Corporation _____: www.formica.com.
 - 2) Wilsonart International, Inc _____: www.wilsonart.com.
 - 2. Exposed Edge Treatment: Square, substrate built up to minimum 1-1/4 inch thick; covered with matching laminate.
 - 3. Back and End Splashes: Same material, same construction.
- C. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
 - 1. Flat Sheet Thickness: 1/4 inch, minimum.
 - 2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA-2 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - a. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
 - b. Colors, Patterns, and Finishes: Equal to Formica; Grade 02
 - c. Manufacturers:
 - 1) Avonite Surfaces _____: www.avonitesurfaces.com.
 - 2) Dupont _____: www.corian.com.
 - 3) Formica Corporation _____: www.formica.com.
 - 4) Wilsonart International, Inc _____: www.wilsonart.com.
 - 3. Other Components Thickness: 1/2 inch, minimum.
 - 4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; radiused edge; use marine edge at sinks.
 - 5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.

2.02 ACCESSORY MATERIALS

- A. Wood-Based Components:
 - 1. Wood fabricated from old growth timber is not permitted.

- B. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch thick; joint lengths using metal splines.
- C. Particleboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 45 pcf minimum density; minimum 3/4 inch thick; joint lengths using metal splines.
- D. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
- E. Joint Sealant: Mildew-resistant silicone sealant, white.

2.03 FABRICATION

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
 - 1. Join lengths of tops using best method recommended by manufacturer.
 - 2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
 - 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
 - 1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
 - 2. Height: 4 inches, unless otherwise indicated.
- C. Solid Surfacing: Fabricate tops up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.
- D. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on drawings, finished to match.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- B. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch.

C. Seal joint between back/end splashes and vertical surfaces.

3.04 TOLERANCES

A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.

B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.

C. Field Joints: 1/8 inch wide, maximum.

3.05 CLEANING

A. Clean countertops surfaces thoroughly.

3.06 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 31 10 00 - SITE CLEARING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Clearing and protection of vegetation.
- B. Removal of existing debris.

1.02 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary: Limitations on Contractor's use of site and premises.
- B. Section 01 50 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- C. Section 01 70 00 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 SITE CLEARING

- A. Comply with other requirements specified in Section 01 70 00.
- B. Minimize production of dust due to clearing operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

3.02 EXISTING UTILITIES AND BUILT ELEMENTS

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Protect existing structures and other elements that are not to be removed.

3.03 VEGETATION

- A. Scope: Remove trees, shrubs, brush, and stumps in areas to be covered by building structure, paving, playing fields, lawns, and planting beds.
- B. Do not remove or damage vegetation beyond the limits indicated on drawings.
- C. Install substantial, highly visible fences at least 3 feet high to prevent inadvertent damage to vegetation to remain:
 - 1. At vegetation removal limits.
 - 2. Around trees to remain within vegetation removal limits; locate no closer to tree than at the drip line.
 - 3. Around other vegetation to remain within vegetation removal limits.
- D. In areas where vegetation must be removed but no construction will occur other than pervious paving, remove vegetation with minimum disturbance of the subsoil.

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following items which apply to all Division 22 sections:
1. Submittals.
 2. Record documents.
 3. Maintenance manuals.
 4. Piping materials and installation instructions common to most piping systems.
 5. Transition fittings.
 6. Dielectric fittings.
 7. Mechanical sleeve seals.
 8. Sleeves.
 9. Escutcheons.
 10. Grout.
 11. Flashing.
 12. Through penetration firestop assemblies.
 13. Plumbing demolition.
 14. Equipment installation requirements common to equipment sections.
 15. Painting and finishing.
 16. Supports and anchorages.
- B. Related Documents:
1. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and the other sections of this Division.
 2. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, and spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PE: Polyethylene plastic.
 - 4. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.
- H. Firestopping (Through-Penetration Protection System): Sealing of stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.3 SUBMITTALS

- A. Product Data for each kind of product indicated.
- B. Welding certificates.
- C. Firestopping Schedules: 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. Submittal of shop drawings, product data, and samples will be accepted only when signed and submitted by this Contractor and the General Contractor. Data submitted from subcontractors and material suppliers directly to the Architect/Engineer will not be processed.
- E. Shop drawings submitted without this Contractor's signature or approval and verification will not be approved. Quantities will not be checked or verified. It is the Contractor's responsibility to provide the proper quantities required to complete the job.
- F. Portions of the work requiring a shop drawing submittal shall not begin until the shop drawing has been approved by the Engineer.
- G. Submit wiring diagrams for all equipment requiring field wiring clearly showing all required connections. This Contractor will send one copy of Engineer approved shop drawings to the Electrical Contractor with a transmittal letter. Forward one copy of the transmittal letter to the Engineer's office.
- H. Where catalog cuts are used, mark them to indicate equipment, capacities, controls, fittings, valves, sizes, etc.

- I. Reference each item to applicable specification paragraph number and plan sheet number. Reference items not appearing in base specification to applicable alternate numbers, change order numbers, letters of authorization, etc.
- J. Engineers acceptance of Compliance Submittals will not relieve Contractor from his responsibility for any deviations from the requirements of the Contract Documents unless Contractor has in writing called Engineer's attention to such deviation at the time of submission and Engineer has given written approval to the specific deviation, nor shall any acceptance by Engineer relieve Contractor from responsibility for errors or omissions in Compliance Submittals.

1.4 GENERAL WORK REQUIREMENTS

A. Permits:

- 1. Obtain and pay for all licenses and permits, fees, inspection and certificates required for the execution of this work.
- 2. Pay fees and charges for connection to outside services and use of property.
- 3. Deliver permits and certificates to the Architect to be transmitted to the Owner.

B. Utility Services:

- 1. This Contractor shall pay for all expenses, deposits, reimbursements, etc., required by the local rules and codes for the service to the buildings, complete and ready for use. See plot plan.
- 2. Consult gas, water and sewer utility for their requirements and for coordinating with their installation. Contractor shall provide any work thus required beyond that indicated by the drawings and specifications. He shall bear all expense involved for the complete installation of the gas service (both temporary and permanent) to the building ready for operation, including utility service charges, except as specifically excluded on the plans.
- 3. This Contractor shall consult all local departments to verify requirements and bid installation for service in accordance with local codes and Utility company rules and regulations.

1.5 RESPONSIBILITY

- A. This Contractor will be held responsible for any and all damage to any part of the building or to the work of other contractors, as may be caused through his operation.
- B. This contractor shall make all provisions for entry of equipment, installed under this contract, to the installed location. This contractor shall provide openings in existing construction if necessary. This contractor shall do all repair necessary to restore the building to the original condition. During the period of entry of equipment and removal of trash, no disruption of the Owner's normal business shall occur.

1.6 QUALITY ASSURANCE

- A. Execute work in compliance with all applicable Federal, State and Municipal laws, codes, ordinances, and local customs regarding the trade to perform the work. The Contractor is required to verify that all installations comply with applicable codes. The codes applicable to this specific project may be listed on the Architect's code compliance sheet. If not, it is

the Contractor's responsibility to determine which codes apply to the installations. Where code requirements conflict with those shown on the drawings and specifications, the code requirements shall take precedence. The Contractor shall notify the Architect immediately of any discrepancies between the applicable code requirements and the documents. Changes made to comply with the applicable requirements shall not justify an additional cost.

- B. Inspect the existing site and conditions and check the drawings and specifications to be fully informed of the requirements for completion of the work. Lack of such information shall not justify an extra to the contract price.
- C. The Plumbing Work shall include labor, materials, and equipment to install systems and place in proper working order, as shown on plans and hereinafter specified. The installation shall include all labor, materials, tools, transportation, equipment, services and facilities, required for the complete, proper and substantial installation of all mechanical work shown on the plans, and/or outlined in these specifications. The installation shall include all materials, appliances, and apparatus not specifically mentioned herein or noted on the drawings but which are necessary to make a complete working installation of all mechanical systems.
- D. Material and equipment shall be new, of best quality and design and free from defects. A manufacturer's nameplate affixed in a conspicuous place will be required on each major component of equipment stating manufacturer's name, address and catalog number.
- E. Furnish testing equipment and test all piping systems under methods and conditions as specified.
- F. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- G. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- H. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- I. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 and ASTM E814 with 0.10 inch water gage (24.9 Pa) minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - 1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
 - 2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.

- a. Floor Penetrations within Wall Cavities: T-Rating is not required.
- J. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
 - 1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
 - 2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- K. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
- L. Fire Resistant Joints between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage (24.9 Pa) minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- M. Surface Burning Characteristics: 25/50 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.8 WORKMANSHIP AND COORDINATION

- A. Make installation substantially as shown on plans.
- B. Pipe and duct routing and equipment location shown on the drawings are schematic in nature. Make alterations in location of apparatus or piping as may be required to conform to building construction without extra charge.
- C. Equipment service clearances, per equipment manufacturer's specifications, shall be maintained from general construction. No pipe shall be installed within these clearances. No piping shall be installed above electrical panels, starters or switchgear, or in elevator equipment rooms.
- D. Cooperate with other contractors in their installation of work.
- E. The ductwork shall take precedence over all pipe work except where it is necessary to maintain an even grade on the piping.
- F. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- G. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

- H. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces.
- I. Use only experienced mechanics.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply sealants, caulking, or mastic materials outside the range of the manufacturer's installation instructions.
- B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F (15 degrees C).
- C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.
- D. Provide ventilation in areas to receive solvent cured materials.

1.10 ELECTRONIC DOCUMENT REQUESTS

- A. The Contractor may request the use of the bidding documents in electronic format (CAD, BIM, PDF etc.) for use in preparation of shop drawings and coordination drawings.
- B. Professional Engineering Consultants, P.A. (PEC) reserves the right to refuse requests for electronic files at its sole discretion. The format of the files will be at PEC's sole discretion.
- C. All electronic documents provided are provided on an as-is basis, and are utilized by the Contractor at his own risk. All files provided by the Engineer are subject to PEC's standard "CADD/Electronic File Disclaimer". This disclaimer can be provided upon request.
- D. At PEC's sole discretion, per sheet fee of up to \$50 may be required to cover the costs of preparing the electronic files for transmission.
- E. By obtaining the bid document CAD or BIM files, the Contractor is not relieved from his duty to create construction, shop and coordination drawings.

1.11 RECORD DOCUMENTS

- A. Prepare record documents in accordance with Division 1. These drawings shall reflect the actual "As-Built" condition including any change orders, of the mechanical systems and installation. In addition to the requirements specified in Division 1, indicate the following installed conditions:
 - 1. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Refer to Identification Section. Indicate actual inverts and horizontal locations of underground piping.
 - 2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 - 3. Approved substitutions, contract modifications, and actual equipment and materials installed.

1.12 MAINTENANCE MANUALS

- A. Prepare Maintenance Manuals in accordance with Division 1 Sections. In addition to the requirements specified in Division 1, include the following information for equipment items:
 - 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 - 2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control stopping, shutdown, and emergency instructions.
 - 3. Maintenance procedures for routing preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 - 4. Approved shop drawing submittals.
 - 5. Servicing instructions and lubrication charts and schedules.
 - 6. Copy of valve tag chart.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified or pre-approved equals.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials.

2.4 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

2.5 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Stainless steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.6 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.

- G. Molded PE: Reusable, PE, tapered-cup shaped and smooth-outer surface with nailing flange for attaching to wooden forms.

2.7 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated and rough brass.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.8 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.9 FLASHING

- A. Metal Flashing: 26 gage (0.5 mm) thick galvanized steel.
- B. Metal Counterflashing: 22 gage (0.8 mm) thick galvanized steel.
- C. Lead Flashing:
 - 1. Waterproofing: 5 lb./sq. ft (24.5 kg/sq m) sheet lead.
 - 2. Soundproofing: 1 lb./sq. ft (5 kg/sq m) sheet lead.
- D. Flexible Flashing: 47 mil (1.2 mm) thick sheet of material compatible with roofing. Coordinate with Architectural roofing specifications.

- E. Caps: Steel, 22 gage (0.8 mm) minimum; 16 gage (1.5 mm) at fire resistant elements.

2.10 FIRESTOPPING

A. Manufacturers:

1. Hilti Corp.
2. 3M fire Protection Products

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. Silicone Firestopping Elastomeric Firestopping: Single or multiple component silicone elastomeric compound and compatible silicone sealant.
2. Foam Firestopping Compounds: Single or multiple component foam compound.
3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
4. Fiber Stuffing and Sealant Firestopping: Composite of mineral or ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.
5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
7. Firestop Pillows: Formed mineral fiber pillows.

C. Color: As selected from manufacturer's full range of colors.

D. Coordinate the above requirements with Division 7.

2.11 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

C. General:

1. Furnish UL listed products.
2. Select products with rating not less than rating of wall or floor being penetrated.

D. Non-Rated Surfaces:

1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

2.12 ACCESS DOORS

- A. If specified in Division 7 that section shall apply. Where not specified in Division 7 provide access doors as follows.
- B. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
- C. Frames: 16-gage steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
 - 1. For installation in masonry, concrete, ceramic tile, or wood paneling: 1 inch-wide-exposed perimeter flange and adjustable metal masonry anchors.
 - 2. For gypsum wallboard or plaster: perforated flanges with wallboard bead.
 - 3. For full-bed plaster applications: galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.
- D. Flush Panel Doors: 14-gage sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
 - 1. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
- E. Locking Devices: Where indicated, provide 5-pin or 5-disc type cylinder locks, individually keyed; provide 2 keys.
- F. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Bar-Co., Inc.
 - 2. J.L. Industries.
 - 3. Karp Associates, Inc.
 - 4. Milcor Div. Inryco, Inc.
 - 5. Nystrom, Inc.

2.13 DRIP PANS

- A. Provide drip pans fabricated from corrosion-resistant sheet metal with watertight joints, and with edges turned up 2-1/2". Reinforce top, either by structural angles or by rolling top over 1/4" steel rod. Provide hole, gasket, and flange at low point for watertight joint and 1" drainline connections.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION REQUIREMENTS

- A. The existing areas surrounding the remodel area are fully occupied and shall remain operational throughout the duration of this project.

- B. This contractor shall closely coordinate with the Owner and/or his representative the timing and schedule for any temporary cutoffs of any mechanical systems. The valve location and scheduled shutdown shall be closely coordinated with the Owner. It is recognized that temporary shutdown of systems will be required. These shall be scheduled in advance with Owner's representatives and restored to full service at the end of the work period.
- C. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- D. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.
- E. Contractor shall provide protective plastic drop cloths to protect the existing occupied areas and equipment from dust and debris during the construction work, and shall clean the areas of all construction dirt daily, and upon completion of the work.
- F. Connection to existing piping for HVAC, medical gas, fire sprinkler or domestic water will require temporary shutdown of those mains to accomplish the new tie-ins. Closely coordinate and schedule this work with the Owner. Perform such work on weekends or nights as required by Owner's use and schedule.
- G. All drained piping risers and mains shall be refilled with fluid and properly vented by this Contractor.
- H. Coordinate with General Contractor the removal and replacement of all existing ceilings, walls, etc. as required for mechanical demolition work.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are specially noted and approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or stamped steel type with polished chrome-plated finish.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type or stamped steel with polished chrome-plated finish.
 - f. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw.
 - g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.
 - h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
 - 2. Existing Piping: Use the following:
 - a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and spring clips.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass or stamped steel type with chrome-plated finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass or stamped steel type with chrome-plated finish.
 - e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.

- f. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
 - g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
 - b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 07 for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Sections for materials and installation.
- O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.3 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected. The Contractor shall field verify all existing conditions and dimensions. The Contractor shall make field adjustments as required to accommodate the new work.
- B. Verify final equipment locations for roughing-in.
- C. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.4 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D2661 Appendixes.
 - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 - 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657 using manufacturer certified mechanics and tools.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.5 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.6 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.7 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with Division 1. In addition to the requirements specified in Division 1, the following requirements apply:
 - 1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
- B. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
 - 1. Uncover work to provide for installation of ill-timed work.
 - 2. Remove and replace defective work.
 - 3. Remove and replace work not conforming to requirements of the Contract Documents.
 - 4. Remove samples of installed work as specified for testing.
 - 5. Install equipment and materials in existing structures.
 - 6. Upon written instructions from the Architect, uncover and restore work to provide for Architect/Engineer observation of concealed work.

3.8 PAINTING

- A. Painting of plumbing systems, equipment, and components is specified in other divisions.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.9 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

3.10 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.11 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

3.12 INSTALLATION - FLASHING

- A. Provide flexible flashing and metal counterflashing where piping penetrates weather or waterproofed walls, floors, and roofs. Refer to Division 7.
- B. Seal floor, shower, and mop sink drains watertight to adjacent materials.

3.13 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping 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 firestopping material in sufficient thickness to achieve required fire and smoke rating. Install per manufacturer's instructions to comply with appropriate listing.
- D. Fire Rated Surface:
 - 1. Seal openings as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch (25 mm) on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch (25 mm) void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
- E. Non-Rated Surfaces:
 - 1. Seal openings, where required by code, through non-fire rated openings as follows:

- a. Install sleeve through opening and extending beyond minimum of 1 inch (25 mm) on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch (25 mm) void between sleeve and building element.
 - c. Install type of firestopping material recommended by manufacturer.
- 2. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
 - 3. Interior partitions: Seal pipe penetrations at clean rooms, laboratories, hospital spaces, computer rooms, telecommunication rooms, and data rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and pipe.
- F. Inspect installed firestopping for compliance with specifications and submitted schedule.
 - G. Clean adjacent surfaces of firestopping materials.

3.14 INSTALLATION OF ACCESS DOORS

- A. Provide access doors in construction wherever access is required for valves, dampers, equipment, etc.
- B. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.
- C. Adjust hardware and panels after installation for proper operation.

3.15 INSTALLATION OF DRIP PANS

- A. Locate drip pans under piping passing within 3' horizontally of electrical equipment, and elsewhere as indicated. Hang from structure with rods and building attachments, weld rods to sides of drip pan. Brace to prevent sagging or swaying. Connect 1" drain line to drain connection, and run to nearest plumbing drain or elsewhere as indicated.

3.16 CLEANING

- A. Refer to Division 1 for general requirements for final cleaning.
- B. Contractor shall clean work area of all construction dirt and debris at the end of each work day.

3.17 WARRANTIES

- A. Refer to Division 1 for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements.
- B. Compile and assemble the warranties as specified into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference.
- C. Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; and names,

addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

- D. This Contractor shall warrant all material and equipment installed by him for a period of one year after completion of the project.

END OF SECTION

SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bronze angle valves.
2. Brass ball valves.
3. Bronze ball valves.

B. Related Documents:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section and the other sections of this Division.
2. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.3 ACTION SUBMITTALS

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

1.4 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 2. ASME B31.1 for power piping valves.

3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
1. Protect internal parts against rust and corrosion.
 2. Protect threads, flange faces, grooves, and weld ends.
 3. Set angle, valves closed to prevent rattling.
 4. Set ball and plug valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
1. Gear Actuator: For quarter-turn valves NPS 6 (DN 150) and larger.
 2. Handlever: For quarter-turn valves NPS 4 (DN 100) and smaller.
- E. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:
1. Ball Valves: With extended operating handle of non-thermal-conductive material, 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.
 3. Solder Joint: With sockets according to ASME B16.18.

4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE ANGLE VALVES

A. Class 125, Bronze Angle Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Hammond Valve.
- b. Milwaukee Valve Company.

2. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded.
- e. Stem and Disc: Bronze.
- f. Packing: Asbestos free.
- g. Handwheel: Malleable iron, bronze, or aluminum.

B. Class 150, Bronze Angle Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co., Crane Valve Group; Stockham Division.
- b. Kitz Corporation.

2. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 300 psig (2070 kPa).
- c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
- d. Ends: Threaded.
- e. Stem and Disc: Bronze.
- f. Packing: Asbestos free.
- g. Handwheel: Malleable iron, bronze, or aluminum.

2.3 BRASS BALL VALVES

A. Two-Piece, Full-Port, Brass Ball Valves with Brass 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. Legend Valve.
- h. Milwaukee Valve Compoany.
- i. NIBCO INC
- j. Red-White Valve Corporation.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Forged brass.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Brass.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

2.4 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- b. Conbraco Industries, Inc.; Apollo Valves
- c. Crane Co.; Crane Valve Group; Crane Valves
- d. Hammond Valve
- e. Legend Valve.
- f. Milwaukee Valve Company.
- g. NIBCO INC.
- h. Red-White Valve Corporation.
- i. Viega
- j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded or press fit.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze, blowout proof.
- i. Handle: Metal with powder coating.

- j. Ball: Chrome-plated brass.
- k. Port: Full.

B. Two-Piece, Regular-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division
 - e. Hammond Valve.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Viega
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded or press fit.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze, blowout proof.
 - i. Handle: Metal with powder coating.
 - j. Ball: Chrome-plated brass.
 - k. Port: Regular.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball valves.
 - 2. Throttling Service: Ball 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 (DN 50) and Smaller: Threaded or solder end.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged or threaded end.
 - 3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged or threaded ends.
 - 6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.
 - 7. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller:
 - 1. Bronze Angle Valves: Class 125, bronze disc.
 - 2. Ball Valves: Two piece, full port, brass or bronze with brass or bronze trim.

END OF SECTION

SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Building attachments.
6. Pipe stands.
7. Pipe positioning systems.
8. Equipment supports.
9. Miscellaneous equipment.

B. Related Documents:

1. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and the other sections of this Division.
2. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.

1.2 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

1.3 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.

4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. 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.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel or stainless steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Allied Tube & Conduit.
 2. Cooper B-Line, Inc.
 3. Unistrut Corporation; Tyco International, Ltd.
- B. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
- C. Standard: MFMA-4.
- D. Channels: Continuous slotted steel channel with inturred lips.
- E. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
- F. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.
- G. Metallic Coating: Hot-dipped galvanized.
- H. Paint Coating: Epoxy.
- I. Plastic Coating: Polyurethane.

2.4 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carpenter & Paterson, Inc.
 - 2. Clement Support Services.
 - 3. ERICO International Corporation.
 - 4. National Pipe Hanger Corporation.
 - 5. PHS Industries, Inc.
 - 6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 - 7. Piping Technology & Products, Inc.
 - 8. Rilco Manufacturing Co., Inc.
 - 9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) 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 (688-kPa) or ASTM C 552, Type II cellular glass with 100-psig (688-kPa) 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 (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.5 BUILDING ATTACHMENTS

- A. General: Except as otherwise indicated, provide factory- fabricated building attachments comply with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Attachment materials to building structure shall be approved by the Structural Engineer.
- B. Where concrete structure occurs hang piping using 1/2" diameter Phillips red head wedge anchors or equal by Hilti.
 - 1. Concrete Inserts: MSS Type 18.
 - 2. Top Beam C-Clamps: MSS Type 19.
 - 3. Side Beam or Channel Clamps: MSS Type 20.
 - 4. Center Beam Clamps: MSS Type 21.
 - 5. Welded Beam Attachments: MSS Type 22.
 - 6. C-Clamps: MSS Type 23.
 - 7. Top Beam Clamps: MSS Type 25.
 - 8. Side Beam Clamps: MSS Type 27.
 - 9. Steel Beam Clamps with Eye Nut: MSS Type 28.
 - 10. Linked Steel Clamps with Eye Nut: MSS Type 29.

11. Malleable Beam Clamps: MSS Type 30.
12. Steel Brackets: One of the following for indicated loading:
 - a. Light Duty: MSS Type 31.
 - b. Medium Duty: MSS Type 32.
 - c. Heavy Duty: MSS Type 33.
13. Side Beam Brackets: MSS Type 34.
14. Plate Lugs: MSS Type 57.
15. Horizontal Travelers: MSS Type 58.

2.6 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece plastic or stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 2. Base: Plastic or stainless steel.
 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:
 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 2. Bases: One or more; plastic.
 3. Vertical Members: Two or more protective-coated-steel channels.
 4. Horizontal Member: Protective-coated-steel channel.
 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.9 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly supporting 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. Installation of Building Attachments:
 - 1. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.
 - 2. Use power driven anchors or expansion anchors at concrete structure.
 - 3. Install supplementary steel angles, fastened or welded to building structure as required to support pipe and accessories. Use 3" x 3" x 1/4" steel angle with long leg vertical, or heavier if required.
- F. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Sections for how system interfaces with roofing system.
- G. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 22 plumbing fixture Sections for requirements for pipe positioning systems for plumbing fixtures.
- H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. 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.
- N. 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 (DN 100) and larger if pipe is installed on rollers.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
 - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
5. Pipes NPS 8 (DN 200) and Larger: Include reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.5 PAINING

- A. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 INSTALLATION - PIPE HANGER AND SUPPORT

- A. Install in accordance with ASME B31.9, MSS SP 58, MSS SP69, and MSS SP 89.
- B. Support horizontal and vertical piping as scheduled.
- C. Install hangers with minimum 1/2 inch (13 mm) space between finished covering and adjacent work.
- D. Provide clearance in hangers and from structure and other equipment for installation of insulation.
- E. Use hangers with 1-1/2 inch (38 mm) minimum vertical adjustment.
- F. Design hangers for pipe movement without disengagement of supported pipe
- G. Comply with MSS SP-69 for pipe-hanger selections and applications that are not otherwise specified.
- H. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.
- I. Use stainless-steel pipe hangers, fiberglass pipe hangers, fiberglass strut systems and stainless-steel or corrosion-resistant attachments for outdoors and/or hostile environment applications.
- J. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing. Use vinyl-coated hangers and attachments for PEX, PVC, and CPVC piping. Use stainless steel hangers and stainless steel attachments on stainless steel pipes.
- K. Use padded hangers for piping that is subject to scratching, including plastic pressure piping and all glass piping.
- L. Use thermal-hanger shield inserts for insulated piping and tubing.
- M. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified elsewhere, 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 (DN 15 to DN 750).
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F (566 deg C), pipes NPS 4 to NPS 24 (DN 100 to DN 600), requiring up to 4 inches (100 mm) of insulation.

3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8 (DN 20 to DN 200).
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
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 (DN 100 to DN 900), 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 (DN 100 to DN 900), 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 (DN 65 to DN 900) 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 (DN 25 to DN 750), 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 (DN 65 to DN 600), 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 (DN 50 to DN 1050) 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 (DN 50 to DN 600) 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 (DN 50 to DN 750) if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

N. Vertical-Piping Clamps: Unless otherwise indicated and except as specified elsewhere, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- O. Hanger-Rod Attachments: Unless otherwise indicated and except as specified elsewhere, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.
- P. Building Attachments: Unless otherwise indicated and except as specified elsewhere, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb (340 kg).
 - b. Medium (MSS Type 32): 1500 lb (680 kg).
 - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

Q. Saddles and Shields: Unless otherwise indicated and except as specified elsewhere, 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.

R. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not otherwise specified.

S. Comply with MFMA-103 for metal framing system selections and applications that are not otherwise specified.

T. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

U. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.7 PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

3.8 SCHEDULES

HORIZONTAL PIPE HANGER SPACING		
PIPE MATERIAL	MAXIMUM HANGER SPACING Feet (m)	HANGER ROD DIAMETER Inches (mm)
Cast Iron to 5 inch	5 (1.5)	5/8 (15)
Cast Iron 6 to 12 inch	5 (1.5)	7/8 (22)
Cast Iron with 10 foot (3 m) length of pipe to 5 inch	10 (3)	5/8 (15)
Cast Iron with 10 foot (3m) length of pipe 6 to 12 inch	10 (3)	7/8 (22)
CPVC, 1 inch (25 mm) and smaller	3 (0.9)	1/2 (13)
CPVC, 1-1/4 inch (32 mm) to 3 inch (75)	4 (1.2)	1/2 (13)
CPVC, 4 inch (100) to 8 inch (200)	4 (1.2)	7/8 (22)
Copper Tube, 1-1/4 inch (32 mm) and smaller	5 (1.5)	3/8 (10)
Copper Tube, 1-1/2 inch (38 mm) to 5 inches (DN125)	8 (2.4)	1/2 (13)
Polypropylene 3 inches (75 mm) and smaller	3 (.9)	1/2 (13)
Polypropylene 4 inches (100 mm) to 8 inches (200 mm)	4 (1.2)	7/8 (22)
PVC 3 inches (75 mm) and smaller	4 (1.2)	1/2 (13)
PVC 4 inches (100 mm) to 8 inch (100 mm)	4 (1.2)	7/8 (22)

PVDF up to 3 inch (75 mm)	2.5 (.75)	1/2 (13)
PVDF 4 inch (100mm) to 6 inch (150 mm)	4 (12)	3/4 (19)
Stainless Steel or Steel, 3 inches (75 mm) and smaller	12 (3.7)	1/2 (13)
Stainless Steel or Steel, 4 inches (100 mm) to 6 inch (150 mm)	12 (3.7)	3/4 (19)
Stainless Steel or Steel, 8 inches (200 mm) and larger	12 (3.7)	7/8 (22)

- NOTE: 1. Where code requirements for hangers are more stringent than above, code requirements shall apply.
2. Place hangers within 12 inches (300 mm) of each horizontal elbow, fitting, valve and coupling.
3. Support horizontal cast iron pipe adjacent to each hub.
4. Rod diameters may be reduced one size for double-rod hangers, with 3/8 inch (10mm) minimum rods.

VERTICAL PIPE SUPPORT SPACING	
PIPE MATERIAL	MAXIMUM SUPPORT SPACING Feet (m)
Cast Iron	15 (4.5)
CPVC 1 inch (25 mm) and smaller	5 (1.5)
CPVC 1-1/4 inch (32mm) and larger	6 (1.8)
Copper Tube	10 (3)
Polypropylene	5 (1.5)
PVC	4 (1.2)
PVDF	4 (1.2)
Steel or Stainless Steel	15 (4.5)

- NOTE: 1. Where not otherwise indicated, support vertical piping at each floor.
2. Support cast iron at hubs.
3. Support riser piping independently of connected horizontal piping.

END OF SECTION

SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Valve tags.
5. Warning tags.

B. Related Documents:

1. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and the other sections of this Division.
2. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.

1.2 SUBMITTALS

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

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label including color scheme, wording, symbols, and letter size.

D. Valve numbering scheme including color scheme, wording, symbols, and letter size.

E. Valve Schedules: For each piping system to include in maintenance manuals including color scheme.

1.3 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch (0.8-mm); Stainless steel, 0.025-inch (0.64-mm); Aluminum, 0.032-inch (0.8-mm); or anodized aluminum, 0.032-inch (0.8-mm) 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 (64 by 19 mm).
3. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
2. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
4. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
5. Fasteners: Stainless-steel rivets or self-tapping screws.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.

- B. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- D. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- E. Fasteners: Stainless-steel rivets or self-tapping screws.
- F. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- G. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover or cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
 - 1. Tag Material: Multilayer, multicolored plastic, 0.0625 inch (1.6mm); Brass, 0.032-inch (0.8-mm); Stainless steel, 0.025-inch (0.64-mm); Aluminum, 0.032-inch (0.8-mm); or anodized aluminum, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 1. Size: Approximately 4 by 7 inches (100 by 178 mm).
 2. Fasteners: Brass grommet and wire.
 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 4. Color: Yellow background with black lettering.

2.6 PLASTIC UNDERGROUND PIPE MARKERS

- A. Brightly colored continuously printed plastic ribbon tape, minimum 6 inches (150 mm) wide by 4 mil (0.10 mm) thick, manufactured for direct burial service.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten plastic or metal labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; mechanical 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. 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 (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings.
 8. There shall be a minimum of one label for each system per room.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; 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.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.6 UNDERGROUND PIPE MARKERS

- A. Install underground plastic pipe markers 6 to 8 inches (150 to 200 mm) below finish grade, directly above buried pipe.

END OF SECTION

SECTION 22 07 00 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plumbing piping insulation, jackets and accessories.
2. Plumbing equipment insulation, jackets and accessories.

B. Related Documents:

1. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and the other sections of this Division.
2. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.

1.2 REFERENCES

A. ASTM International:

1. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
3. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
4. ASTM C450 - Standard Practice for Prefabrication and Field Fabrication of Thermal Insulating Fitting Covers for NPS Piping, Vessel Lagging, and Dished Head Segments.
5. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
6. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
7. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
8. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
9. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
10. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
11. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
12. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

B. National Fire Protection Association:

1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

C. Underwriters Laboratories Inc.:

1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

A. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.

B. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.

C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84, UL 723, and NFPA 255. Any items exposed in return air plenums shall not exceed 25/50 for flame and smoke.

B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.

C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.

D. Perform work in accordance with applicable local and state codes.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

B. Applicator: Company specializing in performing Work of this section with minimum three years experience.

1.6 PRE-INSTALLATION MEETINGS

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

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.
- B. Maintain temperature before, during, and after installation for minimum period of 24 hours.

1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Manufacturers for Glass Fiber and Mineral Fiber Insulation Products:

- 1. CertainTeed.
- 2. Knauf.
- 3. Johns Manville.
- 4. Owens-Corning.

- B. Manufacturers for Closed Cell Elastomeric Insulation Products:

- 1. Aeroflex. Aerocell.
- 2. Armacell, LLC. Armaflex.
- 3. Nomaco. K-flex.

2.2 PIPE INSULATION

- A. TYPE P-1: ASTM C547, molded glass fiber pipe insulation. Conform to ASTM C795 for application on Austenitic stainless steel.

- 1. Thermal Conductivity: 0.23 at 75 degrees F (0.034 at 24 degrees C).
- 2. Operating Temperature Range: 0 to 850 degrees F (minus 18 to 454 degrees C).
- 3. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied reinforced foil kraft with self-sealing adhesive joints.
- 4. Jacket Temperature Limit: minus 20 to 150 degrees F (minus 29 to 66 degrees C).

- B. TYPE P-2: ASTM C534, Type I, flexible, closed cell elastomeric insulation, tubular.

- 1. Thermal Conductivity: 0.28 at 75 degrees F (0.040 at 25 degrees C).
- 2. Operating Temperature Range: Range: Minus 70 to 220 degrees F (minus 57 to 104 degrees C)

2.3 PIPE INSULATION JACKETS

- A. PVC Plastic Pipe Jacket:

- 1. Product Description: ASTM D1784, One piece molded type fitting covers and sheet material, off-white color.

2. Thickness: 30 mil (51 mm).
3. Connections: Brush on welding adhesive or tacks.

B. Aluminum Pipe Jacket:

1. ASTM B209.
2. Thickness: 0.032 inch (0.80 mm) thick sheet.
3. Finish: Embossed.
4. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
5. Fittings: 0.016 inch (0.4 mm) thick die shaped fitting covers with factory attached protective liner.
6. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.020 inch (0.50 mm) thick stainless steel.

2.4 PIPE INSULATION ACCESSORIES

- A. Vapor Retarder Lap Adhesive: Compatible with insulation.
- B. Covering Adhesive Mastic: Compatible with insulation.
- C. Piping 1-1/2 inches (40 mm) diameter and smaller: Galvanized steel insulation protection shield. MSS SP-69, Type 40. Length: Minimum 6 inches (150 mm) long.
- D. Piping 2 inches (50 mm) diameter and larger: Wood insulation saddle, hard maple. Inserts length: not less than 6 inches (150 mm) long, matching thickness and contour of adjoining insulation.
- E. Closed Cell Elastomeric Insulation Pipe Hanger: Polyurethane insert with aluminum or stainless steel jacket single piece construction with self adhesive closure. Thickness to match pipe insulation.
- F. Adhesives: Compatible with insulation.

2.5 EQUIPMENT INSULATION

- A. TYPE E-1: ASTM C612; glass fiber, rigid board, noncombustible with factory applied foil scrim kraft jacket.
 1. Thermal Conductivity: 0.24 at 75 degrees F (0.035 24 degrees C).
 2. Operating Temperature Range: 0 to 450 degrees F (minus 18 to 232 degrees C).
 3. Density: 3.0 pound per cubic foot (48 kilogram per cubic meter).
 4. Jacket Temperature Limit: minus 20 to 150 degrees F (minus 29 to 66 degrees C).
- B. TYPE E-2: ASTM C534, Type II, flexible, closed cell elastomeric insulation, sheet.
 1. Thermal Conductivity: 0.27 at 75 degrees F (0.039 at 25 degrees C).
 2. Operating Temperature Range: Range: Minus 70 to 220 degrees F (minus 57 to 105 degrees C).

2.6 EQUIPMENT INSULATION JACKETS

- A. PVC Plastic Equipment Jacket:

1. Product Description: ASTM D1784, sheet material, off-white color.
2. Minimum Service Temperature: minus 40 degrees F (minus 40 degrees C).
3. Maximum Service Temperature: 150 degrees F (66 degrees C).
4. Moisture Vapor Transmission: ASTM E96; 0.002 perm-inches.
5. Thickness: 30 mil (0.75 mm).
6. Connections: Brush on welding adhesive or tacks.
7. PVC jackets installed outdoors shall be UV resistant.

B. Aluminum Equipment Jacket:

1. ASTM B209.
2. Thickness: 0.025 inch (0.64 mm) thick sheet.
3. Finish: Embossed.
4. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
5. Fittings: 0.016 inch (0.4 mm) thick die shaped fitting covers with factory attached protective liner.
6. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.010 inch (0.25 mm) thick stainless steel.

2.7 EQUIPMENT INSULATION ACCESSORIES

- A. Vapor Retarder Lap Adhesive: Compatible with insulation.
- B. Covering Adhesive Mastic: Compatible with insulation.

2.8 ADHESIVES:

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; Aero seal.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H.B. Fuller Company; 85-75.
 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify piping and equipment has been tested before applying insulation materials.
- B. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION - PIPING SYSTEMS

- A. Piping Exposed to View in Finished Spaces: Locate insulation and cover seams in least visible locations.
- B. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Division 07 for penetrations of assemblies with fire resistance rating greater than one hour.
- C. Piping Systems Conveying Fluids Below Ambient Temperature:
 - 1. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
 - 2. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
 - 3. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.
- D. Glass Fiber Board Insulation:
 - 1. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with stud, pins, clips, adhesive, wires, or bands.
 - 2. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
 - 3. Cover wire mesh or bands with cement to a thickness to remove surface irregularities.
- E. Hot Piping Systems at or less than 140 degrees F (60 degrees C):
 - 1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
 - 3. Do not insulate unions and flanges at equipment, but bevel and seal ends of insulation at such locations.
- F. Inserts and Shields:
 - 1. Piping 1-1/2 inches (40 mm) Diameter and Smaller: Install galvanized steel shield between pipe hanger and insulation.
 - 2. Piping 2 inches (50 mm) Diameter and Larger: Install insert between support shield and piping and under finish jacket.
 - a. Insert Configuration: Minimum 6 inches (150 mm) long, of thickness and contour matching adjoining insulation; may be factory fabricated.
 - b. Insert Material: Compression resistant insulating material suitable for planned temperature range and service.

3. Piping Supported by Roller Type Pipe Hangers: Install galvanized steel shield between roller and inserts.
- G. Insulation Terminating Points:
1. Condensate Piping: Insulate entire piping system and components to prevent condensation.
- H. Closed Cell Elastomeric Insulation:
1. Push insulation on to piping.
 2. Miter joints at elbows.
 3. Seal seams and butt joints with manufacturer's recommended adhesive.
 4. When application requires multiple layers, apply with joints staggered.
 5. Insulate fittings and valves with insulation of like material and thickness as adjacent pipe.
- I. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet (3 meters) above finished floor): Finish with PVC jacket and fitting covers.
- J. Prepare pipe insulation for finish painting. Refer to Division 09.

3.3 INSTALLATION - EQUIPMENT

- A. Factory Insulated Equipment: Do not insulate.
- B. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- C. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
- D. Equipment Containing Fluids Below Ambient Temperature:
1. Insulate entire equipment surfaces.
 2. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
 3. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
 4. Finish insulation at supports, protrusions, and interruptions.

3.4 SCHEDULES

A. Water Supply Services Piping Insulation Schedule:

PIPING SYSTEM	INSULATION TYPE	PIPE SIZE	INSULATION THICKNESS inches (mm)
Domestic Hot Water Supply and Recirculation	P-1	1-1/2 inches (50 mm) and smaller 2 inches (65 mm) and larger	1.0 (25) * 1.5 (40) *
Domestic Cold Water	P-1	All Sizes	1.0 (25)

B. Drainage Services Piping Insulation Schedule:

PIPING SYSTEM	INSULATION TYPE	PIPE SIZE	INSULATION THICKNESS inches (mm)
Storm Piping (horizontal and vertical above ground within building)	P-1	All sizes	1.0 (25)
Storm Piping (vertical above ground in chases and in walls).	P-1	All sizes	0.5 (13)

C. Equipment Insulation Schedule:

EQUIPMENT	INSULATION TYPE	INSULATION THICKNESS inches (mm)
Roof Drain Bodies	E-1 or E-2	0.5 (13)

END OF SECTION

SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Building service entrance piping extending to 5'-0" outside the building.
3. Flexible connectors.

B. Related Documents:

1. Drawings and general provisions of the contract, including General and Supplementary conditions and Division 01 specification sections, apply to this section and the other sections of this Division.
2. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.

1.2 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 61 for potable domestic water piping and components.

1.3 PROJECT CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of water service.
2. Do not proceed with interruption of water service without Architect's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L or K (ASTM B 88M, Type A or B) water tube, drawn temper.

1. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
 4. Copper Pressure-Seal-Joint Fittings: ASME B16.18 or ASME B16.23.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Viega; Plumbing and Heating Systems
 - 2) Preapproved equal
 - b. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - c. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 5. Copper-Tube Extruded-Tee Connections:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) T-DRILL Industries Inc.
 - b. Description: Tee formed in copper tube according to ASTM F 2014.
 - c. Use only for mains of 2-1/2" line size and larger with branch lines at least two pipe sizes smaller than the main.
 6. Rolled Grooved-Joint Copper-Tube Appurtenances:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Victaulic Company
 - 2) Anvil International (Gruvlok).
 - b. Copper Grooved-End Fittings: ASTM B 75 (ASTM B 75M) copper tube or ASTM B 584 bronze castings.
 - c. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606 - include ferrous housing sections, EPDM rubber gaskets suitable for hot and cold water and bolts and nuts.
- B. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) water tube, annealed temper.
1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, 95-5 Tin-Antimony lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 FLEXIBLE CONNECTORS

- A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig (1380 kPa).
 - 2. End Connections NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.
 - 3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged copper alloy.
- B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig (1380 kPa).
 - 2. End Connections NPS 2 (DN 50) and Smaller: Threaded steel-pipe nipple.
 - 3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements elsewhere in specifications for excavating, trenching, and back-filling.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook." Install tubing without joints if possible. If joints are required, they shall be brazed.
- C. Install shutoff valve immediately upstream of each dielectric fitting.

- D. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- E. Install seismic restraints on piping as required.
- F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- G. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space. Provide space to permit insulation applications, with 1 inch clearance outside the insulation.
- I. Install piping adjacent to equipment and specialties to allow service and maintenance.
- J. Install piping to permit valve servicing.
- K. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- L. Install piping free of sags and bends.
- M. Install fittings for changes in direction and branch connections.
- N. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

- F. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2144. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- H. Copper-Tubing Grooved Joints: Roll groove end of tube. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for roll-grooved joints.
- I. Stainless Steel-Piping Grooved Joints: Roll groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- J. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.
- L. Provide air compression chambers equal to 12 pipe diameters, 18" maximum, on all water supply connections to fixtures and equipment, except where water hammer arresters are installed.

3.4 VALVE INSTALLATION

- A. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball valves for piping NPS 2 (DN 50) and smaller.
- B. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

3.5 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. NPS 1-1/2 (DN 40) and Smaller: Fitting-type coupling.
 - 2. NPS 2 (DN 50) and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 (DN 50) and Smaller: Plastic-to-metal transition fittings or unions.

3.6 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric couplings or nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.
- D. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.
- E. Use dielectric unions where specifically shown on the plans.

3.7 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge manifold connections to each domestic water booster pump.
- B. Install bronze-hose flexible connectors in copper domestic water tubing.
- C. Install stainless-steel-hose flexible connectors in stainless steel domestic water piping.

3.8 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
- B. Support piping and tubing not otherwise listed according to MSS SP-69, plumbing code, and manufacturer's written instructions.

3.9 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. 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 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 (DN 65) and larger.

3.10 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.

3.11 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.12 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entry into building.
- B. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.13 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 section “IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT” for identification of materials and installation.
- B. Where multiple system pressures exist, label pressure piping with system operating pressure.

3.14 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 4. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow standing for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 6. Prepare reports for tests and for corrective action required.
- D. Domestic water piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.15 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 calibrated balancing valves in hot-water-circulation return piping to provide adequate flow or to flows indicated.
 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.16 CLEANING

- A. Clean and disinfect domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:

- 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow standing for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow standing for three hours.
- c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

3.17 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. Use minimum number of joints possible in below floor piping.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

DOMESTIC WATER PIPING SERVICE DESCRIPTION	PIPING	FITTINGS
Under-Building Slab NPS 2 (DN 50) and smaller	Soft Copper Tube Type K (Type A)	Wrought Copper Brazed Joints (only where joints are required)
Above Ground NPS 2 (DN 50) and smaller	Hard Copper Tube Type L (Type B)	Wrought Copper Soldered Joints
		Copper Pressure-Seal Pressure Sealed Joints

3.18 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 valves for piping NPS 2 (DN 50) and smaller.
 2. Throttling Duty: Use ball valves for piping NPS 2 (DN 50) and smaller. Use ball valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
 3. Drain Duty: Hose-end drain valves.

END OF SECTION

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

B. Related Documents:

1. Drawings and general provisions of the contract, including General and Supplementary conditions and Division 01 specification sections, apply to this section and the other sections of this Division.
2. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.

1.2 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. LLDPE: Linear, low-density polyethylene plastic.
- C. NBR: Acrylonitrile-butadiene rubber.
- D. PE: Polyethylene plastic.
- E. PVC: Polyvinyl chloride plastic.
- F. TPE: Thermoplastic elastomer.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.
- C. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-DWV" for plastic drain, waste, and vent piping and "NSF-SEWER" for plastic sewer piping.

1.5 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 no fewer than two days in advance of proposed interruption of sanitary waste service.
 - 2. Do not proceed with interruption of sanitary waste service without Architect's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class.
- B. Gaskets: ASTM C 564, rubber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky.
 - b. Charlotte Pipe
 - c. Dallas Specialty & Mfg. Co.
 - d. Fernco Inc.
 - e. Matco-Norca, Inc.
 - f. MIFAB, Inc.
 - g. Mission Rubber Company; a division of MCP Industries, Inc.
 - h. Stant.
 - i. Tyler Pipe.
 - 2. Standards: ASTM C 1277 and CISPI 310.
 - 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 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. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Solvent Cement: ASTM D 2564.
 - 1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31.

3.2 EXAMINATION

- A. Verify existing grades, inverts, utilities, obstacles, and topographical conditions prior to installations.
- B. Examine rough-in requirements for plumbing fixtures and other equipment having drain connections to verify actual locations of piping connections prior to installation.
- C. Examine walls, floors, roof, and plumbing chases for suitable conditions where piping and specialties are to be installed.
- D. Do not proceed until unsatisfactory conditions have been corrected.

3.3 PREPARATION OF FOUNDATION FOR UNDERGROUND BUILDING DRAINS

- A. Grade trench bottoms to provide a smooth, firm, and stable foundation, free from rock, throughout the length of the pipe.
- B. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid and backfill with clean sand or pea gravel to indicate invert elevation.
- C. Shape bottom of trench to fit bottom of pipe for 90-degrees (bottom 1/4 of the circumference). Fill unevenness with tamped sand backfill. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to ensure continuous bearing of the pipe barrel on the foundation.

3.4 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on 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. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. 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.
- L. 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.
- M. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Horizontal Sanitary Drain Piping: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
 - 2. Vent Piping: Shall slope down toward vertical fixture vent.

- N. 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."
- O. Install aboveground PVC piping according to ASTM D 2665.
- P. Install underground PVC piping according to ASTM D 2321.
- Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Common Work Results for Plumbing."
- S. Install mechanical sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for mechanical sleeve seals specified in Division 22 Section "Common Work Results for Plumbing."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Common Work Results for Plumbing."

3.5 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- C. 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.
- D. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- E. 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. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Support piping and tubing not otherwise listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 4. Install test tees (wall cleanouts) in risers near floor and floor cleanouts with cover flush with floor.
 5. Install horizontal backwater valves with cleanout cover flush with floor or in pit with pit cover flush with floor.
 6. Comply with requirements for backwater valves, cleanouts and drains specified in Division 22 Section "Sanitary Waste Piping Specialties."
 7. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.
- D. 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 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If piping does not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.

3.10 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.

3.11 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

Soil & Waste Piping	Above Ground	4" (DN100) and smaller	Service class, cast-iron soil pipe & fittings; gaskets; & gasketed joints.
			Hubless, cast-iron soil pipe & fittings; CISPI hubless-piping couplings; & cast-iron, hubless-piping couplings.
Vent Piping	Above Ground	4" (DN100) and smaller	Service class, cast-iron soil pipe & fittings; gaskets; & gasketed joints.
			Hubless, cast-iron, soil pipe & fittings; CISPI hubless piping couplings; & coupled joints.
			Copper DWV tube, copper drainage fittings, & soldered joints
			Solid-wall PVC pipe, PVC socket fittings, & solvent-cemented joints. (a)
Soil, Waste & Vent Piping	Underground	All Sizes	Service class, cast-iron soil piping; gaskets; & gasketed joints.
			Solid-wall PVC pipe (to NPS 12 (DN300)); PVC socket fittings; & solvent-cemented joints.

Notes: (a) This piping material is not to be installed in a return air plenum.

END OF SECTION

SECTION 22 14 16 - STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipe, tube, and fittings.
 - 2. Specialty pipe fittings.
- B. Related Documents:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section and the other sections of this Division.
 - 2. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.

1.2 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Storm Drainage Piping: 10-foot head of water (30 kPa).

1.3 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and shall be listed by NSF International.
- C. Comply with NSF/ANSI 14, "Plastics Piping System Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

1.4 PROJECT CONDITIONS

- A. Interruption of Existing Storm-Drainage 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 no fewer than two days in advance of proposed interruption of storm-drainage service.
 - 2. Do not proceed with interruption of storm-drainage service without Architect's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service classes.
- B. Gaskets: ASTM C 564, rubber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky.
 - b. Charlotte Pipe
 - c. Dallas Specialty & Mfg. Co.
 - d. Fernco Inc.
 - e. Matco-Norca, Inc.
 - f. MIFAB, Inc.
 - g. Mission Rubber Company; a division of MCP Industries, Inc.
 - h. Stant.
 - i. Tyler Pipe.
 - 2. Standards: ASTM C 1277 and CISPI 310.
 - 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 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. Shielded, Non-pressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Cascade Waterworks Mfg. Co.
 - 2) Mission Rubber Company; a division of MCP Industries, Inc.
- b. Standard: ASTM C 1460.
- c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31.

3.2 EXAMINATION

- A. Verify existing grades, inverts, utilities, obstacles, and topographical conditions prior to installations.
- B. Do not proceed until unsatisfactory conditions have been corrected.

3.3 PREPARATION OF FOUNDATION FOR UNDERGROUND STORM DRAINS

- A. Grade trench bottoms to provide a smooth, firm, and stable foundation, free from rock, throughout the length of the pipe.
- B. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid and backfill with clean sand or pea gravel to indicate invert elevation.
- C. Shape bottom of trench to fit bottom of pipe for 90 degrees (bottom 1/4 of the circumference). Fill unevenness with tamped sand backfill. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to ensure continuous bearing of the pie barrel on the foundation.

3.4 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations from 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. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- L. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- M. Install storm drainage piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Storm Drain: 1 percent downward in direction of flow.
 - 2. Horizontal Storm-Drainage Piping: 1 percent downward in direction of flow.
- N. 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."
- O. Install steel piping according to applicable plumbing code.
- P. Install aboveground PVC piping according to ASTM D 2665.
- Q. Install underground PVC piping according to ASTM D 2321.
- R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Common Work Results for Plumbing."
- T. Install mechanical sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for mechanical sleeve seals specified in Division 22 Section "Common Work Results for Plumbing."

- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Common Work Results for Plumbing."

3.5 JOINT CONSTRUCTION

- A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Hubless, Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads 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.
- D. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fittings. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- 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, Non-pressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.6 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in OD's.
 - 2. In Drainage Piping: Shielded, non-pressure transition couplings.
 - 3. In Aboveground Pressure Piping: Fitting-type transition couplings.
 - 4. In Underground Pressure Piping:
 - a. NPS 1-1/2 (DN 40) and Smaller: Fitting-type transition couplings.
 - b. NPS 2 (DN 50) and Larger: Pressure transition couplings.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

- B. Support piping and tubing not otherwise listed according to MSS SP-69 and manufacturer's written instructions.

3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.
 - 1. Install test tees (wall cleanouts) in rainleaders near floor, and floor cleanouts with cover flush with floor.
 - 2. Install horizontal backwater valves with cleanout cover flush with floor or in pit with pit cover flush with floor.
 - 3. Comply with requirements for backwater valves, cleanouts, and drains specified in Division 22 Section "Storm Drainage Piping Specialties."
- 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 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.9 IDENTIFICATION

- A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.10 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
 - 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 piping does not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.11 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.12 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

SERVICE DESCRIPTION	LOCATION	SIZE	PIPING AND FITTINGS
Storm Drainage Piping (Rainleaders)	Above Ground	6" and Smaller	Service class, cast-iron soil pipe & fittings; gaskets; & gasketed joints.
			Hubless, cast-iron soil pipe & fittings; CISPI hubless-piping couplings; or heavy duty hubless-piping couplings.
Storm Drainage Piping (Rainleaders)	Above Ground	8" and Larger	Service class, cast-iron soil pipe & fittings; gaskets; & gasketed joints.
			Hubless, cast-iron soil pipe & fittings; heavy duty hubless-piping couplings; & cast-iron, hubless-piping couplings.
Storm Drainage Piping (Rainleaders)	Underground	All Sizes	Service class, cast-iron soil piping; gaskets; & gasketed joints.
			Solid-wall PVC pipe (to NPS 12 (DN300)); PVC socket fittings; & solvent-cemented joints.

NOTES: (a) PVC piping material is not to be installed in a return air plenum

END OF SECTION

SECTION 22 14 19 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof drains.
2. Miscellaneous storm drainage piping specialties.
3. Cleanouts.

B. Related Documents:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section and the other sections of this Division.
2. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

- A. NPS 6 (DN 150) and Larger Cast-Iron, Large-Sump, General-Purpose Roof Drains (RD or RD-1).

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe. (Wade)
 - e. Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.4, for general-purpose roof drains.
3. Body Material: Cast iron.
4. Dimension of Body: Nominal 14-inch (357-mm) diameter.

5. Combination Flashing Ring and Gravel Stop: Required.
 6. Extension Collars: Required when roof insulation exceeds 2" at drain.
 7. Underdeck Clamp: Required.
 8. Expansion Joint: As required.
 9. Sump Receiver Plate or Bearing Pan: As required to suit project conditions.
 10. Dam: Required on overflow roof drains to elevate drain flow 2" above primary roof drain.
 11. Dome Material: Cast iron.
- B. NPS 3 to NPS 4 (DN 75 to DN 100) Cast-Iron, Medium-Sump, General-Purpose Roof Drains (RD-2):
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe. (Wade)
 - e. Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASME A112.6.4, for general-purpose roof drains.
 3. Body Material: Cast iron.
 4. Dimension of Body: 8- to 12-inch (203- to 305-mm) diameter.
 5. Combination Flashing Ring and Gravel Stop: Required.
 6. Extension Collars: Require when roof insulation exceeds 2" at draw.
 7. Underdeck Clamp: Required.
 8. Expansion Joint: As required.
 9. Sump Receiver Plate or Bearing Pan: As required to suit project conditions.
 10. Dam: Required on overflow roof drains to elevate drain flow 2" above primary roof drain.
 11. Dome Material: Cast iron.

2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

- A. Downspout Adaptors:
1. Description: Manufactured, steel or gray-iron casting, for attaching to horizontal-outlet, parapet roof drain and to exterior, sheet metal downspout.
 2. Size: Inlet size to match parapet drain outlet.
- B. Downspout Boots:
1. Description: Manufactured, ASTM A 48/A 48M, cast-iron casting, with strap or ears for attaching to building; NPS 4 (DN 100) outlet; and shop-applied bituminous coating.
 2. Size: Inlet size to match downspout and NPS 4 (DN 100) outlet.
 3. Finish: nickel bronze, polished bronze or plain bronze as selected by the Architect.
- C. Downspout Nozzles:

1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
2. Size: Same as connected downspout.
3. Finish: nickel bronze, polished bronze or plain bronze as selected by the Architect.

2.3 CLEANOUTS

A. Exposed Metal Cleanouts (CO):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Floor Cleanouts(CO):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Div.
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: If required.
7. Outlet Connection: Inside calk or spigot.
8. Closure: Brass plug with straight threads and gasket, or brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads, set-screws or other device.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy duty where vehicle traffic is possible, medium duty in all other areas.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts(WCO):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, drilled-and-threaded brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07 Sections.
 1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 2. Install expansion joints, if indicated, in roof drain outlets.
 3. Position roof drains for easy access and maintenance.
 4. Overflow roof drains shall have a 2" dam or be positioned 2" higher than the location of primary roof drains.
- B. Install downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.
- C. Install downspout boots at grade with top 6 inches (152 mm) above grade. Secure to building wall.
- D. Install downspout nozzles at exposed bottom of rainleaders where they spill onto grade.
- E. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:
 1. Use cleanouts the same size as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
 2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
 3. Locate cleanouts at minimum intervals of 100 feet (30 m).
 4. Locate cleanouts at base of each vertical rainleader.

- F. For floor cleanouts for piping below floors, install cleanout covers with top flush with finished floor.
- G. For cleanouts in piping concealed in walls, install cleanout wall access covers, of types indicated, with cover flush with finished wall.
- H. Install wall cleanouts in vertical rainleaders. Install access door in wall if indicated.
- I. Install through-penetration firestop assemblies in plastic rainleaders at concrete floor penetrations.
- J. Install sleeve flashing device with each rainleader passing through floors with waterproof membrane.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 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

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following conventional plumbing fixtures and related components:
 - 1. Faucets for sinks.
 - 2. Sinks.
- B. Related Documents:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section and other sections of this division.
 - 2. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
- E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- F. FRP: Fiberglass-reinforced plastic.
- G. PMMA: Polymethyl methacrylate (acrylic) plastic.
- H. PVC: Polyvinyl chloride plastic.
- I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.3 SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- 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. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Stainless-Steel Residential Sinks: ASME A112.19.3.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - 1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
 - 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 - 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 - 4. Faucets: ASME A112.18.1.
 - 5. Hose-Connection Vacuum Breakers: ASSE 1011.

6. Hose-Coupling Threads: ASME B1.20.7.
7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
8. NSF Potable-Water Materials: NSF 61.
9. Pipe Threads: ASME B1.20.1.
10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
11. Supply Fittings: ASME A112.18.1.
12. Brass Waste Fittings: ASME A112.18.2.

PART 2 - PRODUCTS

2.1 REFERENCES

- A. See "Plumbing Fixture List" in the plumbing drawings for more precise description, including "Basis of Design" product.
- B. See "Plumbing Fixture Schedule" in the plumbing drawings for sizes of runouts and connections to water, waste and vent.

2.2 SINK FAUCETS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 1. American Standard Companies, Inc.
 2. Bradley Corporation.
 3. Chicago Faucets.
 4. Delta Faucet Company.
 5. Elkay Manufacturing Co.
 6. Just Manufacturing Company.
 7. Kohler Co.
 8. Speakman Company.
 9. T & S Brass and Bronze Works, Inc.
 10. Zurn Industries, LLC.
- B. Description: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 1. Body Material: Commercial, solid brass.
 2. Finish: Polished chrome plate or as indicated.

2.3 SINKS

- A. Sinks:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Elkay Manufacturing Co.
 - b. Just Manufacturing Company.
 - c. Kohler Co.

2. Description: Residential, counter-mounting, stainless-steel kitchen sink.
 - a. Metal Thickness: 0.050 inch (1.3 mm).
 - b. Faucet: Sink.
 - c. Supplies: NPS 1/2 (DN 15) chrome-plated copper with stops.
 - d. Drain Piping: NPS 1-1/2 (DN 40) chrome-plated, cast-brass P-trap; 0.045-inch- (1.1-mm-) thick tubular brass waste to wall; continuous waste; and wall escutcheon(s).

B. Bar Sinks:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Elkay Manufacturing Co.
 - b. Just Manufacturing Company.
 - c. Kohler Co.
2. Description: Single-bowl, counter-mounting, stainless-steel bar sink.
 - a. Faucet: Faucet.
 - b. Supplies: Chrome-plated copper with stops.
 - c. Drain Piping: NPS 1-1/2 (DN 40) chrome-plated, cast-brass P-trap; 0.045-inch- (1.1-mm-) thick tubular brass waste to wall; and wall escutcheon.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install counter-mounting fixtures in and attached to casework.
- C. Install fixtures level and plumb according to roughing-in drawings.
- D. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- E. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
 - F. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
 - G. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
 - H. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
 - I. Install traps on fixture outlets.
 1. Exception: Omit trap on fixtures with integral traps.
 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
 - J. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
 - K. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
 - L. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

3.4 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.

3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following items which apply to all Division 23 sections:
1. Submittals.
 2. Record documents.
 3. Maintenance manuals.
 4. Piping materials and installation instructions common to most piping systems.
 5. Transition fittings.
 6. Dielectric fittings.
 7. Mechanical sleeve seals.
 8. Sleeves.
 9. Escutcheons.
 10. Grout.
 11. Flashing.
 12. Through penetration firestop assemblies.
 13. HVAC demolition.
 14. Equipment installation requirements common to equipment sections.
 15. Painting and finishing.
 16. Concrete bases.
 17. Supports and anchorages.
- B. Related Documents:
1. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and the other sections of this Division.
 2. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, and spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PE: Polyethylene plastic.
 - 4. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.
- H. Firestopping (Through-Penetration Protection System): Sealing of stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.3 SUBMITTALS

- A. Product Data for each kind of product indicated.
- B. Welding certificates.
- C. Firestopping Schedules: 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. Submittal of shop drawings, product data, and samples will be accepted only when signed and submitted by this Contractor and the General Contractor. Data submitted from subcontractors and material suppliers directly to the Architect/Engineer will not be processed.
- E. Shop drawings submitted without this Contractor's signature or approval and verification will not be approved. Quantities will not be checked or verified. It is the Contractor's responsibility to provide the proper quantities required to complete the job.
- F. Portions of the work requiring a shop drawing submittal shall not begin until the shop drawing has been approved by the Engineer.
- G. Submit wiring diagrams for all equipment requiring field wiring clearly showing all required connections. This Contractor will send one copy of Engineer approved shop drawings to the Electrical Contractor with a transmittal letter. Forward one copy of the transmittal letter to the Engineer's office.
- H. Where catalog cuts are used, mark them to indicate equipment, capacities, controls, fittings, valves, sizes, etc.

- I. Reference each item to applicable specification paragraph number and plan sheet number. Reference items not appearing in base specification to applicable alternate numbers, change order numbers, letters of authorization, etc.
- J. Engineers acceptance of Compliance Submittals will not relieve Contractor from his responsibility for any deviations from the requirements of the Contract Documents unless Contractor has in writing called Engineer's attention to such deviation at the time of submission and Engineer has given written approval to the specific deviation, nor shall any acceptance by Engineer relieve Contractor from responsibility for errors or omissions in Compliance Submittals.

1.4 GENERAL WORK REQUIREMENTS

A. Permits:

- 1. Obtain and pay for all licenses and permits, fees, inspection and certificates required for the execution of this work.
- 2. Pay fees and charges for connection to outside services and use of property.
- 3. Deliver permits and certificates to the Architect to be transmitted to the Owner.

B. Utility Services:

- 1. This Contractor shall pay for all expenses, deposits, reimbursements, etc., required by the local rules and codes for the service to the buildings, complete and ready for use. See plot plan.
- 2. Consult gas, water and sewer utility for their requirements and for coordinating with their installation. Contractor shall provide any work thus required beyond that indicated by the drawings and specifications. He shall bear all expense involved for the complete installation of the gas service (both temporary and permanent) to the building ready for operation, including utility service charges, except as specifically excluded on the plans.
- 3. This Contractor shall consult all local departments to verify requirements and bid installation for service in accordance with local codes and Utility company rules and regulations.

1.5 RESPONSIBILITY

- A. This Contractor will be held responsible for any and all damage to any part of the building or to the work of other contractors, as may be caused through his operation.
- B. This contractor shall make all provisions for entry of equipment, installed under this contract, to the installed location. This contractor shall provide openings in existing construction if necessary. This contractor shall do all repair necessary to restore the building to the original condition. During the period of entry of equipment and removal of trash, no disruption of the Owner's normal business shall occur.

1.6 QUALITY ASSURANCE

- A. Execute work in compliance with all applicable Federal, State and Municipal laws, codes, ordinances, and local customs regarding the trade to perform the work. The Contractor is required to verify that all installations comply with applicable codes. The codes applicable to this specific project may be listed on the Architect's code compliance sheet. If not, it is

the Contractor's responsibility to determine which codes apply to the installations. Where code requirements conflict with those shown on the drawings and specifications, the code requirements shall take precedence. The Contractor shall notify the Architect immediately of any discrepancies between the applicable code requirements and the documents. Changes made to comply with the applicable requirements shall not justify an additional cost.

- B. Inspect the existing site and conditions and check the drawings and specifications to be fully informed of the requirements for completion of the work. Lack of such information shall not justify an extra to the contract price.
- C. The HVAC Work shall include labor, materials, and equipment to install systems and place in proper working order, as shown on plans and hereinafter specified. The installation shall include all labor, materials, tools, transportation, equipment, services and facilities, required for the complete, proper and substantial installation of all mechanical work shown on the plans, and/or outlined in these specifications. The installation shall include all materials, appliances, and apparatus not specifically mentioned herein or noted on the drawings but which are necessary to make a complete working installation of all mechanical systems.
- D. Material and equipment shall be new, of best quality and design and free from defects. A manufacturer's nameplate affixed in a conspicuous place will be required on each major component of equipment stating manufacturer's name, address and catalog number.
- E. Furnish testing equipment and test all piping systems under methods and conditions as specified.
- F. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- G. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- H. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- I. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 and ASTM E814 with 0.10 inch water gage (24.9 Pa) minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - 1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
 - 2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.

- a. Floor Penetrations within Wall Cavities: T-Rating is not required.
- J. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
 - 1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
 - 2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- K. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
- L. Fire Resistant Joints between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage (24.9 Pa) minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- M. Surface Burning Characteristics: 25/50 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.8 WORKMANSHIP AND COORDINATION

- A. Make installation substantially as shown on plans.
- B. Pipe and duct routing and equipment location shown on the drawings are schematic in nature. Make alterations in location of apparatus or piping as may be required to conform to building construction without extra charge.
- C. Equipment service clearances, per equipment manufacturer's specifications, shall be maintained from general construction. No pipe shall be installed within these clearances. No piping shall be installed above electrical panels, starters or switchgear, or in elevator equipment rooms.
- D. Cooperate with other contractors in their installation of work.
- E. The ductwork shall take precedence over all pipe work except where it is necessary to maintain an even grade on the piping.
- F. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- G. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

- H. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces.
- I. Use only experienced mechanics.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply sealants, caulking, or mastic materials outside the range of the manufacturer's installation instructions.
- B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F (15 degrees C).
- C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.
- D. Provide ventilation in areas to receive solvent cured materials.

1.10 ELECTRONIC DOCUMENT REQUESTS

- A. The Contractor may request the use of the bidding documents in electronic format (CAD, BIM, PDF etc.) for use in preparation of shop drawings and coordination drawings.
- B. Professional Engineering Consultants, P.A. (PEC) reserves the right to refuse requests for electronic files at its sole discretion. The format of the files will be at PEC's sole discretion.
- C. All electronic documents provided are provided on an as-is basis, and are utilized by the Contractor at his own risk. All files provided by the Engineer are subject to PEC's standard "CADD/Electronic File Disclaimer". This disclaimer can be provided upon request.
- D. At PEC's sole discretion, per sheet fee of up to \$50 may be required to cover the costs of preparing the electronic files for transmission.
- E. By obtaining the bid document CAD or BIM files, the Contractor is not relieved from his duty to create construction, shop and coordination drawings.

1.11 RECORD DOCUMENTS

- A. Prepare record documents in accordance with Division 1. These drawings shall reflect the actual "As-Built" condition including any change orders, of the mechanical systems and installation. In addition to the requirements specified in Division 1, indicate the following installed conditions:
 - 1. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Refer to Identification Section. Indicate actual inverts and horizontal locations of underground piping.
 - 2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 - 3. Approved substitutions, contract modifications, and actual equipment and materials installed.

1.12 MAINTENANCE MANUALS

- A. Prepare Maintenance Manuals in accordance with Division 1 Sections. In addition to the requirements specified in Division 1, include the following information for equipment items:
 - 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 - 2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control stopping, shutdown, and emergency instructions.
 - 3. Maintenance procedures for routing preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 - 4. Approved shop drawing submittals.
 - 5. Servicing instructions and lubrication charts and schedules.
 - 6. Copy of valve tag chart.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified or pre-approved equals.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials.

2.4 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

2.5 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Stainless steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.6 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.

- G. Molded PE: Reusable, PE, tapered-cup shaped and smooth-outer surface with nailing flange for attaching to wooden forms.

2.7 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated and rough brass.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.8 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.9 FLASHING

- A. Metal Flashing: 26 gage (0.5 mm) thick galvanized steel.
- B. Metal Counterflashing: 22 gage (0.8 mm) thick galvanized steel.
- C. Lead Flashing:
 - 1. Waterproofing: 5 lb./sq. ft (24.5 kg/sq m) sheet lead.
 - 2. Soundproofing: 1 lb./sq. ft (5 kg/sq m) sheet lead.
- D. Flexible Flashing: 47 mil (1.2 mm) thick sheet of material compatible with roofing. Coordinate with Architectural roofing specifications.

- E. Caps: Steel, 22 gage (0.8 mm) minimum; 16 gage (1.5 mm) at fire resistant elements.

2.10 FIRESTOPPING

A. Manufacturers:

1. Hilti Corp.
2. 3M fire Protection Products

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. Silicone Firestopping Elastomeric Firestopping: Single or multiple component silicone elastomeric compound and compatible silicone sealant.
2. Foam Firestopping Compounds: Single or multiple component foam compound.
3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
4. Fiber Stuffing and Sealant Firestopping: Composite of mineral or ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.
5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
7. Firestop Pillows: Formed mineral fiber pillows.

C. Color: As selected from manufacturer's full range of colors.

D. Coordinate the above requirements with Division 7.

2.11 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

C. General:

1. Furnish UL listed products.
2. Select products with rating not less than rating of wall or floor being penetrated.

D. Non-Rated Surfaces:

1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

2.12 ACCESS DOORS

- A. If specified in Division 7 that section shall apply. Where not specified in Division 7 provide access doors as follows.
- B. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
- C. Frames: 16-gage steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
 - 1. For installation in masonry, concrete, ceramic tile, or wood paneling: 1 inch-wide-exposed perimeter flange and adjustable metal masonry anchors.
 - 2. For gypsum wallboard or plaster: perforated flanges with wallboard bead.
 - 3. For full-bed plaster applications: galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.
- D. Flush Panel Doors: 14-gage sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
 - 1. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
- E. Locking Devices: Where indicated, provide 5-pin or 5-disc type cylinder locks individually keyed; provide 2 keys.
- F. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Bar-Co., Inc.
 - 2. J.L. Industries.
 - 3. Karp Associates, Inc.
 - 4. Milcor Div. Inryco, Inc.
 - 5. Nystrom, Inc.

2.13 DRIP PANS

- A. Provide drip pans fabricated from corrosion-resistant sheet metal with watertight joints, and with edges turned up 2-1/2". Reinforce top, either by structural angles or by rolling top over 1/4" steel rod. Provide hole, gasket, and flange at low point for watertight joint and 1" drainline connections.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION REQUIREMENTS

- A. The existing areas surrounding the remodel area are fully occupied and shall remain operational throughout the duration of this project.
- B. This contractor shall closely coordinate with the Owner and/or his representative the timing and schedule for any temporary cutoffs of any mechanical systems. The valve location and scheduled shutdown shall be closely coordinated with the Owner. It is recognized that temporary shutdown of systems will be required. These shall be scheduled in advance with Owner's representatives and restored to full service at the end of the work period.
- C. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
 - 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- D. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.
- E. Contractor shall provide protective plastic drop cloths to protect the existing occupied areas and equipment from dust and debris during the construction work, and shall clean the areas of all construction dirt daily, and upon completion of the work.
- F. Connection to existing piping for HVAC, medical gas, fire sprinkler or domestic water will require temporary shutdown of those mains to accomplish the new tie-ins. Closely coordinate and schedule this work with the Owner. Perform such work on weekends or nights as required by Owner's use and schedule.
- G. All drained piping risers and mains shall be refilled with fluid and properly vented by this Contractor.
- H. Coordinate with General Contractor the removal and replacement of all existing ceilings, walls, etc. as required for mechanical demolition work.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are specially noted and approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or stamped steel type with polished chrome-plated finish.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type or stamped steel with polished chrome-plated finish.
 - f. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw.
 - g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.

- h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
2. Existing Piping: Use the following:
- a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and spring clips.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass or stamped steel type with chrome-plated finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass or stamped steel type with chrome-plated finish.
 - e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
 - f. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
 - g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
 - b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 07 for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Sections for materials and installation.

- O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.3 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected. The Contractor shall field verify all existing conditions and dimensions. The Contractor shall make field adjustments as required to accommodate the new work.
- B. Verify final equipment locations for roughing-in.
- C. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.4 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657 using manufacturer certified mechanics and tools.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.5 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.6 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.7 MECHANICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:
 1. Coordinate mechanical systems, equipment, and materials installation with other building components, including the structure, fire sprinklers, and the electrical lights and equipment.
 2. Verify all dimensions by field measurements.
 3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
 4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
 5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.
 6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 7. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
 8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.
 9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
 10. Install access panel or doors where units are concealed behind finished surfaces.
 11. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope, or systems requiring a fixed access clearance.

12. The Mechanical Contractor shall locate and mark the location of all holes and openings which require blocking out, cutting or core drilling.
13. All square openings through precast concrete shall be blocked out by precast manufacturer. All openings 6" dia. or larger shall be blocked out by precast manufacturer. All holes less than 6" dia. may be core drilled.
14. Contractor shall review with Owner location, accessibility, and method of operating all HVAC shut-off valves located in plumbing chases, ceiling cavity and mechanical rooms.
15. This Contractor shall assist with and provide supervised start-up of the steam, condensate return, hot water and chilled water systems, involving air venting, drainage, etc. Monitor the air venting until all air has been eliminated from the building system and the lines within the buildings are completely filled with fluid, or steam as applicable.
16. The ceiling cavity space is limited. Therefore the ductwork and piping locations shall be closely coordinated with each other as well as the lights, ceiling height, electrical conduit and fire sprinkler piping.
17. It is the intent, where possible, to locate the domestic water piping, medical gas piping, fire sprinkler piping, and HVAC piping above the ductwork and tight to the existing steel and concrete structure. The steam condensate return piping shall, in most cases, be located to run below the ductwork.
18. Selected pipe and duct elevations are shown on the plans as an aid to the contractor in their installation. Where necessary, due to conflicts, these items may be changed as long as conflict with other items does not occur.
19. Ductwork and piping shall rise into the joist or beam space and run between joists or beams where shown on the drawings and as may be required, whether specifically shown or not, to avoid conflict with other trades.
20. This Contractor shall be responsible for coordination with the fire sprinkler subcontractor, plumbing contractor, and the Electrical Contractor as required to avoid and or resolve conflicts. Conflicts between piping, ducts, electrical, sprinklers, etc. shall be resolved with no additional cost or change to the contract amount.
21. Where new work conflicts with existing ductwork or piping (plumbing, HVAC, fire protection, medical gas etc.) this contractor shall relocate those items as required to make way for new work without additional charges.

3.8 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with Division 1. In addition to the requirements specified in Division 1, the following requirements apply:
 1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
- B. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
 1. Uncover work to provide for installation of ill-timed work.
 2. Remove and replace defective work.
 3. Remove and replace work not conforming to requirements of the Contract Documents.
 4. Remove samples of installed work as specified for testing.
 5. Install equipment and materials in existing structures.

6. Upon written instructions from the Architect, uncover and restore work to provide for Architect/Engineer observation of concealed work.

3.9 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in other divisions.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.10 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to codes at Project.
 1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100mm) larger in both directions than supported units.
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 7. Use 3000-psi (20.7MPa) 38-day compressive-strength concrete and reinforcement. Refer to architectural and structural for additional requirements.

3.11 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

3.12 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.13 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

3.14 INSTALLATION - FLASHING

- A. Provide flexible flashing and metal counterflashing where piping penetrates weather or waterproofed walls, floors, and roofs. Refer to Division 7.

3.15 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping 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 firestopping material in sufficient thickness to achieve required fire and smoke rating. Install per manufacturer's instructions to comply with appropriate listing.
- D. Fire Rated Surface:
 - 1. Seal openings as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch (25 mm) on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch (25 mm) void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
- E. Non-Rated Surfaces:
 - 1. Seal openings, where required by code, through non-fire rated openings as follows:

- a. Install sleeve through opening and extending beyond minimum of 1 inch (25 mm) on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch (25 mm) void between sleeve and building element.
 - c. Install type of firestopping material recommended by manufacturer.
- 2. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
 - 3. Interior partitions: Seal pipe penetrations at clean rooms, laboratories, hospital spaces, computer rooms, telecommunication rooms, and data rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and pipe.
- F. Inspect installed firestopping for compliance with specifications and submitted schedule.
 - G. Clean adjacent surfaces of firestopping materials.

3.16 INSTALLATION OF ACCESS DOORS

- A. Provide access doors in construction wherever access is required for valves, dampers, equipment, etc.
- B. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.
- C. Adjust hardware and panels after installation for proper operation.

3.17 INSTALLATION OF DRIP PANS

- A. Locate drip pans under piping passing within 3' horizontally of electrical equipment, and elsewhere as indicated. Hang from structure with rods and building attachments, weld rods to sides of drip pan. Brace to prevent sagging or swaying. Connect 1" drain line to drain connection, and run to nearest drain or elsewhere as indicated.

3.18 CLEANING

- A. Refer to Division 1 for general requirements for final cleaning.
- B. Contractor shall clean work area of all construction dirt and debris at the end of each work day.

3.19 WARRANTIES

- A. Refer to Division 1 for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements.
- B. Compile and assemble the warranties as specified into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference.
- C. Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; and names,

addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

- D. This Contractor shall warrant all material and equipment installed by him for a period of one year after completion of the project.

END OF SECTION

SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes single- and three-phase motors for application on equipment provided under other sections and for motors furnished loose to Project.
- B. Related Documents:
 - 1. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and the other sections of this Division.
 - 2. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.
 - 3. Refer to Division 26 for starters, disconnects, fuses, and variable speed drives.

1.2 REFERENCES

- A. American Bearing Manufacturers Association:
 - 1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- B. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 - Motors and Generators.
- C. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

- A. Product Data: Submit catalog data for each motor furnished loose. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.
- B. Test Reports: Indicate procedures and results for specified factory and field testing and inspection.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Testing Agency: Company member of International Electrical Testing Association and specializing in testing products specified in this section with minimum three years experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.
- B. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.
- C. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) 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.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Class B.
- H. Insulation: Class F.
- I. 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.

- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 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 shall be 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. 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. All motors driven by a variable frequency PWM drive shall include a factory installed maintenance free, circumferential, conductive micro fiber or carbon brush shaft grounding ring to discharge shaft currents to ground. The conductive microfibers shall redirect shaft currents and provide a reliable, very low impedance path from shaft to motor frame by-passing motor bearings entirely. For vertical turbine pump motors, the upper shaft shall be provided with a coating to isolate the shaft from the bearings and the shaft grounding ring shall be installed within the motor casing. This information shall be provided with the shop drawing submittal for verification of method of installation and to ensure they are to be supplied.

2.5 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. Electronically Commutated Motor
 - 1. Motor Enclosure: Open Type.
 - 2. Motor shall be an electronically commutated, permanent magnet, brushless DC type motor (ECM) specifically designed for HVAC applications.
 - 3. Motors shall be permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase.
 - 4. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor.

5. Motor shall be speed controllable down to 20% of full speed (minimum 80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.
 6. Motor shall be a minimum of 85% efficient at all speeds.
- D. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
 - E. Motors 1/20 HP and Smaller: Shaded-pole type.
 - F. 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.

2.6 MOTOR CONNECTIONS

- A. Flexible conduit, except where plug-in electrical cords are specifically indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install securely on firm foundation. Properly align motor with driven machine.
- B. Install engraved plastic nameplates.
- C. Ground and bond motors.

END OF SECTION

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Building attachments.
6. Pipe stands.
7. Pipe positioning systems.
8. Equipment supports.
9. Miscellaneous equipment.

B. Related Documents:

1. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and the other sections of this Division.
2. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.

1.2 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

1.3 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. 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.
 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- C. Copper Pipe Hangers:
1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel or stainless steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Allied Tube & Conduit.
 2. Cooper B-Line, Inc.
 3. Unistrut Corporation; Tyco International, Ltd.
- B. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
- C. Standard: MFMA-4.
- D. Channels: Continuous slotted steel channel with inturred lips.
- E. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
- F. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.
- G. Metallic Coating: Hot-dipped galvanized.
- H. Paint Coating: Epoxy.
- I. Plastic Coating: Polyurethane.

2.4 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carpenter & Paterson, Inc.
 - 2. Clement Support Services.
 - 3. ERICO International Corporation.
 - 4. National Pipe Hanger Corporation.
 - 5. PHS Industries, Inc.
 - 6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 - 7. Piping Technology & Products, Inc.
 - 8. Rilco Manufacturing Co., Inc.
 - 9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) 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 (688-kPa) or ASTM C 552, Type II cellular glass with 100-psig (688-kPa) 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 (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.5 BUILDING ATTACHMENTS

- A. General: Except as otherwise indicated, provide factory- fabricated building attachments comply with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Attachment materials to building structure shall be approved by the Structural Engineer.
- B. Where concrete structure occurs hang piping using 1/2" diameter Phillips red head wedge anchors or equal by Hilti.
 - 1. Concrete Inserts: MSS Type 18.
 - 2. Top Beam C-Clamps: MSS Type 19.
 - 3. Side Beam or Channel Clamps: MSS Type 20.
 - 4. Center Beam Clamps: MSS Type 21.
 - 5. Welded Beam Attachments: MSS Type 22.
 - 6. C-Clamps: MSS Type 23.
 - 7. Top Beam Clamps: MSS Type 25.
 - 8. Side Beam Clamps: MSS Type 27.
 - 9. Steel Beam Clamps with Eye Nut: MSS Type 28.
 - 10. Linked Steel Clamps with Eye Nut: MSS Type 29.

11. Malleable Beam Clamps: MSS Type 30.
12. Steel Brackets: One of the following for indicated loading:
 - a. Light Duty: MSS Type 31.
 - b. Medium Duty: MSS Type 32.
 - c. Heavy Duty: MSS Type 33.
13. Side Beam Brackets: MSS Type 34.
14. Plate Lugs: MSS Type 57.
15. Horizontal Travelers: MSS Type 58.

2.6 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece plastic or stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 2. Base: Plastic or stainless steel.
 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:
 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 2. Bases: One or more; plastic.
 3. Vertical Members: Two or more protective-coated-steel channels.
 4. Horizontal Member: Protective-coated-steel channel.
 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for HVAC fixtures in commercial applications.

2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.9 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly supporting 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. Installation of Building Attachments:
 - 1. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.
 - 2. Use power driven anchors or expansion anchors at concrete structure.
 - 3. Install supplementary steel angles, fastened or welded to building structure as required to support pipe and accessories. Use 3" x 3" x 1/4" steel angle with long leg vertical, or heavier if required.
- F. Pipe Stand Installation:
 - 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Sections for how system interfaces with roofing system.
- G. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each HVAC fixture. See Division 23 HVAC fixture Sections for requirements for pipe positioning systems for HVAC fixtures.
- H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. 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.
- N. 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 (DN 100) and larger if pipe is installed on rollers.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
 4. Shield Dimensions for Pipe: Not less than the following:

- a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
 - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
- 5. Pipes NPS 8 (DN 200) and Larger: Include reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.5 PAINTING

- A. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 INSTALLATION - PIPE HANGER AND SUPPORT

- A. Install in accordance with ASME B31.9, MSS SP 58, MSS SP69, and MSS SP 89.
- B. Support horizontal and vertical piping as scheduled.
- C. Install hangers with minimum 1/2 inch (13 mm) space between finished covering and adjacent work.
- D. Provide clearance in hangers and from structure and other equipment for installation of insulation.
- E. Use hangers with 1-1/2 inch (38 mm) minimum vertical adjustment.
- F. Design hangers for pipe movement without disengagement of supported pipe
- G. Comply with MSS SP-69 for pipe-hanger selections and applications that are not otherwise specified.
- H. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.
- I. Use stainless-steel pipe hangers, fiberglass pipe hangers, fiberglass strut systems and stainless-steel or corrosion-resistant attachments for outdoors and/or hostile environment applications.
- J. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing. Use vinyl-coated hangers and attachments for PEX, PVC, and CPVC piping. Use stainless steel hangers and stainless steel attachments on stainless steel pipes.
- K. Use padded hangers for piping that is subject to scratching, including plastic pressure piping and all glass piping.
- L. Use thermal-hanger shield inserts for insulated piping and tubing.
- M. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified elsewhere, 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 (DN 15 to DN 750).
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F (566 deg C), pipes NPS 4 to NPS 24 (DN 100 to DN 600), requiring up to 4 inches (100 mm) of insulation.

3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8 (DN 20 to DN 200).
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
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 (DN 100 to DN 900), 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 (DN 100 to DN 900), 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 (DN 65 to DN 900) 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 (DN 25 to DN 750), 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 (DN 65 to DN 600), 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 (DN 50 to DN 1050) 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 (DN 50 to DN 600) 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 (DN 50 to DN 750) if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

N. Vertical-Piping Clamps: Unless otherwise indicated and except as specified elsewhere, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- O. Hanger-Rod Attachments: Unless otherwise indicated and except as specified elsewhere, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.
- P. Building Attachments: Unless otherwise indicated and except as specified elsewhere, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb (340 kg).
 - b. Medium (MSS Type 32): 1500 lb (680 kg).
 - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- Q. Saddles and Shields: Unless otherwise indicated and except as specified elsewhere, 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.
- R. 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 (32 mm).
 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.
- S. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not otherwise specified.
- T. Comply with MFMA-103 for metal framing system selections and applications that are not otherwise specified.
- U. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.7 PROTECTION OF FINISHED WORK

- A. Protect adjacent surfaces from damage by material installation.

3.8 SCHEDULES

HORIZONTAL PIPE HANGER SPACING		
PIPE MATERIAL	MAXIMUM HANGER SPACING	HANGER ROD DIAMETER
	Feet (m)	Inches (mm)
CPVC, 1 inch (25 mm) and smaller	3 (0.9)	1/2 (13)
CPVC, 1-1/4 inch (32 mm) to 3 inch (75)	4 (1.2)	1/2 (13)
CPVC, 4 inch (100) to 8 inch (200)	4 (1.2)	7/8 (22)
Copper Tube, 1-1/4 inch (32 mm) and smaller	5 (1.5)	3/8 (10)
Copper Tube, 1-1/2 inch (38 mm) to 5 inches (DN125)	8 (2.4)	1/2 (13)
Polypropylene/Polyethylene 3 inches (75 mm) and smaller	3 (.9)	1/2 (13)
Polypropylene/Polyethylene 4 inches (100 mm) to 8 inches (200 mm)	4 (1.2)	7/8 (22)
PVC 3 inches (75 mm) and smaller	4 (1.2)	1/2 (13)
PVC 4 inches (100 mm) to 8 inch (100 mm)	4 (1.2)	7/8 (22)
Stainless Steel or Steel, 3 inches (75 mm) and smaller	12 (3.7)	1/2 (13)
Stainless Steel or Steel, 4 inches (100 mm) to 6 inch (150 mm)	12 (3.7)	3/4 (19)
Stainless Steel or Steel, 8 inches (200 mm) and larger	12 (3.7)	7/8 (22)

- NOTE: 1. Where code requirements for hangers are more stringent than above, code requirements shall apply.
 2. Place hangers within 12 inches (300 mm) of each horizontal elbow, fitting, valve and coupling.
 3. Support horizontal cast iron pipe adjacent to each hub.
 4. Rod diameters may be reduced one size for double-rod hangers, with 3/8 inch (10mm) minimum rods.

VERTICAL PIPE SUPPORT SPACING	
PIPE MATERIAL	MAXIMUM SUPPORT SPACING
	Feet (m)
CPVC 1 inch (25 mm) and smaller	5 (1.5)
CPVC 1-1/4 inch (32mm) and larger	6 (1.8)
Copper Tube	10 (3)
Polypropylene/Polyethylene	5 (1.5)
PVC	4 (1.2)
Steel or Stainless Steel	15 (4.5)

- NOTE: 1. Where not otherwise indicated, support vertical piping at each floor.
 2. Support cast iron at hubs.
 3. Support riser piping independently of connected horizontal piping.

END OF SECTION

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Valve tags.
5. Warning tags.
6. Duct labels.

B. Related Documents:

1. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and the other sections of this Division.
2. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label including color scheme, wording, symbols, and letter size.
- D. Valve numbering scheme including color scheme, wording, symbols, and letter size.
- E. Valve Schedules: For each piping system to include in maintenance manuals including color scheme.

1.3 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch (0.8-mm); Stainless steel, 0.025-inch (0.64-mm); Aluminum, 0.032-inch (0.8-mm); or anodized aluminum, 0.032-inch (0.8-mm) 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 (64 by 19 mm).
3. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
2. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
4. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
5. Fasteners: Stainless-steel rivets or self-tapping screws.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.

- B. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- D. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- E. Fasteners: Stainless-steel rivets or self-tapping screws.
- F. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- G. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover or cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.4 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
- B. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- D. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- E. Fasteners: Stainless-steel rivets or self-tapping screws.

- F. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- G. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
 - 1. Tag Material: Multilayer, multicolored plastic, 0.0625 inch (1.6mm); Brass, 0.032-inch (0.8-mm); Stainless steel, 0.025-inch (0.64-mm); Aluminum, 0.032-inch (0.8-mm); or anodized aluminum, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4 by 7 inches (100 by 178 mm).
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten plastic or metal labels on each major item of mechanical equipment.

- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; mechanical 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. 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 (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings.
 - 8. There shall be a minimum of one label for each system per room.

3.4 DUCT LABEL INSTALLATION

- A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Blue: For cold-air supply ducts.
 - 2. Yellow: For hot-air supply ducts.
 - 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 - 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet (15 m) in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; 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.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Testing, adjusting, and balancing of air systems.
2. Measurement of final operating condition of HVAC systems.

B. Related Documents:

1. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and the other sections of this Division.
2. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.

1.2 REFERENCES

A. National Environmental Balancing Bureau:

1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.

1.3 SUBMITTALS

- A. Prior to commencing Work, submit proof of latest calibration date of each instrument.
- B. Test Reports: Indicate data on NEBB approved Report forms.
- C. Field Reports: Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- D. Prior to commencing Work, submit report forms or outlines indicating adjusting, balancing, and equipment data required. Include detailed procedures, agenda, sample report forms and Copy of NEBB Certificate of Conformance Certification.
- E. Submit draft copies of report for review prior to final acceptance of Project.
- F. Furnish reports complete with table of contents page and indexing tabs, with cover identification. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Furnish final copy of testing, adjusting, and balancing report for inclusion in operating and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.
- B. Prior to commencing Work, calibrate each instrument to be used.

1.6 QUALIFICATIONS

- A. Agency: Company specializing in testing, adjusting, and balancing of systems specified in this section with minimum ten years documented experience Certified by NEBB.
- B. Perform Work under supervision of NEBB Certified Testing, Balancing and Adjusting Supervisor. Supervisor shall be a registered professional engineer experienced in performance of this Work and licensed at place where Project is located.

1.7 SEQUENCING

- A. Sequence balancing between completion of systems tested and Date of Substantial Completion.

1.8 DESCRIPTION OF WORK:

- A. Extent of testing, adjusting, and balancing work required by this section shall include a preliminary balance of Air systems together with preparation of the systems for, and cooperation with, the independent Air Balance Contractor. This work by the Mechanical Contractor shall include the following:
 - 1. Clean air filters, ductwork, coils, fans, etc. in the air system to remove all construction dust and debris.
 - 2. Start, lubricate and balance all fans. Change and/or adjust drive pulleys on fans to give required RPM.
 - 3. Supply and install balancing dampers as required for final balancing as determined by the balancing engineer.
 - 4. Furnish workmen familiar with this project and of the proper trade to assist the balancing engineer in the air and water balancing. Also make available subject to request by the balancing engineer trained servicemen of the control, and other equipment suppliers to assist as needed during the testing of their portion of the project.
 - 5. Furnish plans, operating manuals, and shop drawings of all equipment installed for use by the Air and Water Balancing Agency.
 - 6. Have all systems in full operation a minimum of 72 hours before Balance Contractor arrives on job.

PART 2 - PRODUCTS

2.1 TESTING AND BALANCING

- A. The Mechanical Contractor shall procure the services of Allied Laboratories, Wichita, Kansas, Energy Management and Control Corporation, Topeka, Kansas or an engineer pre-approved independent test and balance agency to test water and air moving equipment and air distribution and exhaust systems and to supervise the balance and adjustment of these systems. All work shall be done under direct supervision of a qualified and licensed Heating and Ventilating Engineer. The Contractor shall provide access as required, including any necessary scaffolding, and shall cooperate with testing laboratory personnel. All instruments used in this work shall be accurately calibrated within the 9 months prior to initiating work, and maintained in good working order. If requested the tests shall be conducted in the presence of the Mechanical Engineer responsible for the project and/or his representative. Air balance and testing shall not begin until the system has been completed and is in full working order. The Contractor shall award the test and balance contract upon receipt of his contract to proceed with the air conditioning installation, to allow the Air Balance and Testing Engineer to schedule his work in cooperation with other trades involved and comply with completion date. Upon completion of the air conditioning system installation, the Air Balance and Testing Engineer shall perform the following tests, supervise adjustments and system modifications, and compile the test data as required for evaluation and approval.
- B. The independent test and balance agency shall be a full member in good standing of NEBB. All work shall be performed in accordance with the standards set forth by NEBB.
- C. Submit a prebalance check list of items to be performed by the Mechanical Contractor prior to balance.
- D. Submit a test and balance agenda outlining methods, procedures and instrumentation to be used during balancing. This agenda shall be submitted within 3 months after award of the building contract.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify systems are complete and operable before commencing work. Verify the following:
 - 1. Systems are started and operating in safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire, smoke, and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.

11. Duct system leakage is minimized.

3.2 PREPARATION

- A. Furnish instruments required for testing, adjusting, and balancing operations.
- B. Make instruments available to Project/Architect/Engineer to facilitate spot checks during testing.

3.3 INSTALLATION TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 10 percent of design.
- B. Air Outlets and Inlets: Adjust outlets and inlets in space to within plus or minus 10 percent of design.

3.4 ADJUSTING

- A. Verify recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.
- D. Report defects and deficiencies noted during performance of services, preventing system balance.
- E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.5 AIR SYSTEM PROCEDURE

- A. Bring all fans to design RPM.
- B. Bring air volume in each air handling system to the design air volume using pitot tube transverse method.
- C. Test and record fan motor data.
- D. Test and record static pressure and air volume in high velocity duct extremities.
- E. Measure, record and adjust air diffusers and registers to design CFM.
- F. Make recommendations for system modifications and adjustments required to facilitate proper system balancing as determined by preceding test.
- G. Retest and readjust all system segments affected by system modifications.
- H. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.

- I. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.
- J. Vary total system air quantities by adjustment of fan speeds or adjustable sheaves. Coordinate required sheave drive changes with Mechanical Contractor. Vary branch air quantities by damper regulation.
- K. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- L. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.
- M. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- N. At modulating damper locations, take measurements and balance at extreme conditions. Balance variable volume systems at maximum airflow rate, full cooling, and at minimum airflow rate, full heating.

3.6 DATA FILE:

- A. Prepare complete balance report, and data file on all equipment and devices tested indicating name plate data, design requirements and final operating conditions. Prepare drawing showing final CFM adjacent to each supply, return, and exhaust device. Submit seven (7) copies of the final balance report to be distributed as follows:
 - 1. General Contractor - 1 copy
 - 2. Mechanical Contractor - 1 copy
 - 3. Architect - 1 copy
 - 4. Engineer - 1 copy
 - 5. Remaining three (3) copies to be included in the operation and maintenance manuals presented to the Owner.
- B. Final report shall include stamp and/or seal of NEBB certified member.

3.7 RETESTING

- A. Perform all necessary retesting and rebalancing required to bring all systems into compliance with design parameters of $\pm 10\%$ on airflow.
- B. Perform all retesting necessary after contractors rework to bring non-conforming systems into compliance.
- C. Perform all retesting and readjusting as requested by project engineer after review of test report and submit revised report as required.

3.8 INSTRUCTION:

- A. At the completion of the balancing, review the operating and maintenance brochures as supplied by the Mechanical Contractor and supplement these instructions as determined

through balancing experience. Meet with owner's personnel and with Mechanical Contractor and controls subcontractor to review proper operating procedures.

- B. Warranty that the system is set in accordance with values as established by the plans and specifications.

END OF SECTION

SECTION 23 07 00 - HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. HVAC ductwork insulation, jackets, and accessories.

B. Related Documents:

1. Drawings and general provisions of the contract, including General and Supplementary conditions and Division 01 specification sections, apply to this section and the other sections of this Division.
2. Other sections of this Division, and of other Division, may contain requirements that relate to this section.

1.2 REFERENCES

A. Sheet Metal and Air Conditioning Contractors':

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

B. National Fire Protection Association:

1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

C. Underwriters Laboratories Inc.:

1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
2. UL 1978 - Standard for Safety for Grease Ducts.

1.3 SUBMITTALS

A. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.

B. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.

C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84, UL 723, and NFPA 255. All items exposed in return air plenums must not exceed 25/50 for flame and smoke.

- B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.
- C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.
- D. Perform Work in accordance with applicable local and state codes.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Applicator: Company specializing in performing Work of this section with minimum three years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.
- B. Maintain temperature before, during, and after installation for minimum period recommended by manufacturer.

1.8 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Manufacturers for Glass Fiber and Mineral Fiber Insulation Products:
 - 1. CertainTeed.
 - 2. Knauf.
 - 3. Johns Manville.
 - 4. Owens-Corning.
- B. Manufacturers for Closed Cell Elastomeric Insulation Products:
 - 1. Aeroflex. Aerocell.
 - 2. Armacell, LLC. Armaflex.
 - 3. Nomaco. K-flex.

C. Manufacturers for Polyisocyanurate Foam Insulation Products:

1. Dow Chemical Company.

D. Manufacturers for Extruded Polystyrene Insulation Products:

1. Dow Chemical Company.

2.2 PIPE INSULATION

A. TYPE P-1: ASTM C547, molded glass fiber pipe insulation. Conform to ASTM C795 for application on Austenitic stainless steel.

1. Thermal Conductivity: 0.23 at 75 degrees F (0.034 at 24 degrees C).
2. Operating Temperature Range: 0 to 850 degrees F (minus 18 to 454 degrees C).
3. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied reinforced foil kraft with self-sealing adhesive joints.
4. Jacket Temperature Limit: minus 20 to 150 degrees F (minus 29 to 66 degrees C).

B. TYPE P-5: ASTM C534, Type I, flexible, closed cell elastomeric insulation, tubular.

1. Thermal Conductivity: 0.27 at 75 degrees F (0.039 at 25 degrees C).
2. Operating Temperature Range: Range: Minus 70 to 180 degrees F (minus 57 to 82 degrees C).

2.3 PIPE INSULATION JACKETS

A. PVC Plastic Pipe Jacket:

1. Product Description: ASTM D1784, One piece molded type fitting covers and sheet material, off-white color.
2. Thickness: 30 mil (0.76 mm).
3. Connections: Brush on welding adhesive.

B. ABS Plastic Pipe Jacket:

1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
2. Minimum service temperature: -40 degrees F (-40 degrees C).
3. Maximum service temperature of 180 degrees F (82 degrees C).
4. Moisture vapor transmission: ASTM E96; 0.012 perm-inches.
5. Thickness: 30 mil (0.76 mm).
6. Connections: Brush on welding adhesive.

C. Aluminum Pipe Jacket:

1. ASTM B209.
2. Thickness: 0.032 inch (0.80 mm) thick sheet.
3. Finish: Embossed.
4. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
5. Fittings: 0.016 inch (0.4 mm) thick die shaped fitting covers with factory attached protective liner.
6. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.020 inch (0.50 mm) thick stainless steel.

2.4 PIPE INSULATION ACCESSORIES

- A. Vapor Retarder Lap Adhesive: Compatible with insulation.
- B. Covering Adhesive Mastic: Compatible with insulation.
- C. Piping 1-1/2 inches (40 mm) diameter and smaller: Galvanized steel insulation protection shield. MSS SP-69, Type 40. Length: Based on pipe size and insulation thickness.
- D. Piping 2 inches (50 mm) diameter and larger: Wood insulation saddle, hard maple. Inserts length: not less than 6 inches (150 mm) long, matching thickness and contour of adjoining insulation.
- E. Closed Cell Elastomeric Insulation Pipe Hanger: Polyurethane insert with [aluminum] [stainless steel jacket] single piece construction with self-adhesive closure. Thickness to match pipe insulation.
- F. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.
- G. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.
- H. Insulating Cement: ASTM C195; hydraulic setting on mineral wool.
- I. Adhesives: Compatible with insulation.

2.5 DUCTWORK INSULATION

- A. TYPE D-1: ASTM C1290, Type III, flexible glass fiber, commercial grade with factory applied foil scrim craft jacket meeting ASTM C1136, Type II.
 - 1. Thermal Conductivity: 0.27 at 75 degrees F (0.039 at 24 degrees C).
 - 2. Maximum Operating Temperature: 250 degrees F (121 degrees C).
 - 3. Density: 0.75 pound per cubic foot (12 kilogram per cubic meter).
- B. TYPE D-2: ASTM C612, Type IA or IB, rigid glass fiber, with factory applied paintable all service facing meeting ASTM C1136, Type II.
 - 1. Thermal Conductivity: 0.27 at 75 degrees F (0.039 at 24 degrees C).
 - 2. Density: 3.0 pound per cubic foot (48 kilogram per cubic meter).
- C. TYPE D-4: ASTM C1071, Type I, flexible, glass fiber duct liner with coated air side.
 - 1. Thermal Conductivity: 0.26 at 75 degrees F (0.038 at 24 degrees C).
 - 2. Density: 2.0 pound per cubic foot (32 kilogram per cubic meter).
 - 3. Maximum Operating Temperature: 250 degrees F (121 degrees C).
 - 4. Maximum Air Velocity: 6,000 feet per minute (30.5 meter per second).

2.6 DUCTWORK INSULATION JACKETS

- A. Aluminum Duct Jacket:

1. ASTM B209.
 2. Thickness: 0.032 inch (0.80 mm) thick sheet.
 3. Finish: Smooth.
 4. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
 5. Fittings: 0.016 inch (0.4 mm) thick die shaped fitting covers with factory attached protective liner.
 6. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.010 inch (0.25 mm) thick stainless steel.
- B. Vapor Retarder Jacket:
1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 2. Moisture vapor transmission: ASTM E96; [0.02] [1.3] perm.
 3. Secure with pressure sensitive tape.
- C. Membrane Duct Jacket: ASTM D4637; Type I, EPDM; non-reinforced, 0.060 inch (1.5 mm) thick, 48 inch (1220 mm) wide roll; white color.

2.7 DUCTWORK INSULATION ACCESSORIES

- A. Vapor Retarder Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- B. Vapor Retarder Lap Adhesive: Compatible with insulation.
- C. Adhesive: Waterproof, ASTM E162 fire-retardant type.
- D. Liner Fasteners: Galvanized steel, self-adhesive pad, impact applied, or welded with integral or press-on head.
- E. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.
- F. Lagging Adhesive: Fire resistive to ASTM E84, NFPA 255, and UL 723.
- G. Impale Anchors: Galvanized steel, 12 gage self-adhesive pad.
- H. Adhesives: Compatible with insulation.
- I. Membrane Adhesives: As recommended by membrane manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify piping, equipment and ductwork has been tested before applying insulation materials.
- B. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION - PIPING SYSTEMS

- A. Piping Exposed to View in Finished Spaces: Locate insulation and cover seams in least visible locations.
- B. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Division 07 for penetrations of assemblies with fire resistance rating greater than one hour.
- C. Piping Systems Conveying Fluids Below Ambient Temperature:
 - 1. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
 - 2. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
 - 3. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.
- D. Inserts and Shields:
 - 1. Piping 1-1/2 inches (40 mm) Diameter and Smaller: Install galvanized steel shield between pipe hanger and insulation.
 - 2. Piping 2 inches (50 mm) Diameter and Larger: Install insert between support shield and piping and under finish jacket.
 - a. Insert Configuration: Minimum 6 inches (150 mm) long, of thickness and contour matching adjoining insulation; may be factory fabricated.
 - b. Insert Material: Compression resistant insulating material suitable for planned temperature range and service.
 - 3. Piping Supported by Roller Type Pipe Hangers: Install galvanized steel shield between roller and inserts.
- E. Insulation Terminating Points:
 - 1. Cooling Coil Condensate Piping: Insulate entire piping system and components to prevent condensation.
- F. Closed Cell Elastomeric Insulation:
 - 1. Push insulation on to piping.
 - 2. Miter joints at elbows.
 - 3. Seal seams and butt joints with manufacturer's recommended adhesive.
 - 4. When application requires multiple layers, apply with joints staggered.
 - 5. Insulate fittings and valves with insulation of like material and thickness as adjacent pipe.

- G. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet (3 meters) above finished floor): Finish with PVC jacket and fitting covers.
- H. Piping Exterior to Building: Provide vapor retarder jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor retarder cement. Cover with aluminum jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water or on bottom side of horizontal piping.
- I. Prepare pipe insulation for finish painting. Refer to Division 09.

3.3 INSTALLATION - DUCTWORK SYSTEMS

- A. Duct dimensions indicated on Drawings are finished inside dimensions. Increase duct dimension where internal duct liner is specified.
- B. Insulated ductwork conveying air below ambient temperature:
 - 1. Provide insulation with vapor retarder jackets.
 - 2. Finish with tape and vapor retarder jacket.
 - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- C. External Glass Fiber Duct Insulation:
 - 1. Secure insulation with vapor retarder with wires and seal jacket joints with vapor retarder adhesive or tape to match jacket.
 - 2. Secure insulation without vapor retarder with staples, tape, or wires.
 - 3. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
 - 4. Seal vapor retarder penetrations by mechanical fasteners with vapor retarder adhesive.
 - 5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- D. Duct Liner:
 - 1. Adhere insulation with adhesive for 90 percent coverage.
 - 2. Secure insulation with mechanical liner fasteners. Comply with SMACNA Standards for spacing.
 - 3. Seal and smooth joints. Seal and coat transverse joints.
 - 4. Seal liner surface penetrations with adhesive.
 - 5. Cut insulation for tight overlapped corner joints. Support top pieces of liner at edges with side pieces.

3.4 SCHEDULES

- A. Cooling Services Piping Insulation Schedule:

PIPING SYSTEM	INSULATION TYPES	PIPE SIZE	INSULATION THICKNESS inches (mm)
Condensate Piping from Cooling Coils	P-5	All sizes	0.5 (13)
Refrigerant Suction	P-5	3/4inches (20mm) and smaller 1 inch (25mm to 8 inches (200mm)	0.5 (13) 1.0 (25)
Refrigerant Hot Gas	P-5	All sizes	0.5 (13)

Notes:

- a. Not all insulation types listed are allowed in return air plenums. Insulation in air plenums must have a flame and smoke rating of 25/50 or less per ASTM E84.
- b. Insulation type P-5, P-9, or P-10 may be used for piping installed outdoors. Install longitudinal seams on the bottom of the pipe to allow moisture to drain.

B. Ductwork Insulation Schedule:

DUCTWORK SYSTEM	INSULATION TYPE(S) ^{c,d}	INSULATION THICKNESS inches (mm)
Low-Velocity Rectangular Supply Ducts (internally insulated) ^a	D-4	1.0 (25)
Low-Velocity Round and Oval Supply (externally insulated)	D-1	1.5 (40)
Low-Velocity Rectangular Return Ducts (internally insulated) ^a	D-4	0.5 (13)

Notes:

- a. Line exhaust ductwork only in clean air exhaust applications. In applications containing fumes, grease, dirt or water vapor, the internal liner shall be omitted.
- b. For ductwork installed exterior to building, furnish and install weatherproof jacket.
- c. Factory-insulated dual-wall ductwork is not required to be field insulated.
- d. Examples of spaces exposed to outdoor air include ventilated attics, mechanical rooms with louvered openings directly to the outdoors, etc.
- e. Where rectangular ducts are exposed to view (including mechanical rooms), substitute D-2 for D-1.
- f. Internal duct liner is not allowed in the supply or return ductwork in hospital applications.

END OF SECTION

SECTION 23 09 23 - DDC CONTROL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and the other sections of this Division.
- B. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.

1.2 DESCRIPTION OF WORK:

- A. Extent of DDC control systems work required by this section is indicated by drawings and schedules, and by requirements of this section.
 - 1. Control sequences are specified on the drawings.
- B. Refer to other sections for installation of instrument wells, valve bodies, and dampers in mechanical systems; not work of this section.
- C. Refer to electrical sections for the following work; not work of this section.
 - 1. Power supply wiring from power source to power connection on controls and/or unit control panels. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.
 - 2. Interlock wiring between electrically-operated equipment units; and between equipment and field-installed control devices.
 - a. Interlock wiring specified as factory-installed is work of this section.
- D. Provide the following electrical work as work of this section, complying with requirements of electrical sections:
 - 1. TCC shall provide and install low voltage wiring and conduit, and TCC shall terminate low voltage DDC control devices.

1.3 QUALITY ASSURANCE:

- A. Manufacturer's: Temperature controls shall be manufactured by one of the following:
 - 1. Schneider Electric installed by C&C Group to match existing in building.
- B. Installer's Qualifications: Firms specializing and experienced in DDC control system installations for not less than 5 years.
- C. Codes and Standards:
 - 1. Electrical Standards: Provide electrical components control systems which have been UL-listed and labeled, and comply with NEMA standards.

2. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for electric control systems.
3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's specifications for each control device furnished, indicating dimensions, capacities, performance and electrical characteristics, and material finishes, also include installation and start-up instructions.
- B. Shop Drawings: Submit shop drawings for each control system, containing the following information:
 1. Schematic flow diagram of system showing fan coils, valves, and control devices.
 2. Label each control device with setting or adjustable range of control.
 3. Indicate all required electrical wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed. Include a ladder diagram.
 4. Provide details of faces of control panels, including controls, instruments, and labeling.
 5. Include verbal description of sequence of operation.
- C. Maintenance Data: Submit maintenance instructions and spare parts lists for each type of control device, and compressed air stations. Include that type data, product data and shop drawings in maintenance manual; in accordance with requirements of Division 1.

1.5 DELIVERY, STORAGE, AND HANDLING:

- A. Provide factory shipping cartons for each piece of equipment and control device. Maintain cartons while shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment. Store equipment and materials inside and protect from weather.

1.6 DDC TEMPERATURE CONTROLS CONTRACTOR (TCC) BALANCER COORDINATION

- A. First Day: The TCC shall have a technical representative present with the Balancer on the first day of balancing for a minimum of 4 hours of active balancing - temperature controls coordination.
- B. Remainder of Balancing: The TCC shall either:
 1. Have a technical representative continuously present at each step of the continuation of the balancing OR
 2. Furnish the Balancer with the latest DDC software and any required interface device for the duration of the balancing process. This option includes instructing the Balancer in the use of the software until the Balancer is proficient in the use of the software. Software and interface device shall be returned to TCC when balance report has been accepted. There shall be no charge to the owner or to the Balancer for the use of the software, OR

3. Furnish the Balancer with the latest DDC software, any required interface device, and a portable computer for the duration of the balancing process. This option includes instructing the Balancer in the use of the portable computer and the software until the Balancer is proficient in the use of the software. Portable computer, interface device, and software shall be returned to the TCC when balance report has been accepted. There shall be no charge to the Owner or to the Balancer for the use of the software or portable computer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide DDC control systems of one of the following:

1. Schneider Electric

2.2 MATERIALS AND EQUIPMENT:

- A. General: Provide DDC temperature control products in sizes and capacities indicated consisting of valves, dampers, thermostats, clocks, sensors, controllers, and other components as required for complete installation. Except as otherwise indicated, provide manufacturer's standard materials and components as published in their product information; designed and constructed as recommended by manufacturer, and as required for application indicated. Provide control systems with the following functional and construction features:
 - B. Control Valves: Provide factory fabricated DDC control valves of type, body material and pressure class indicated.
 - C. Where type or body material is not indicated, provide selection as determined by manufacturer for installation requirements and pressure class, based on maximum pressure and temperature in piping system. Provide valve size in accordance with scheduled or specified maximum pressure drop across control valve. Equip control valves with electric actuators, with proper shutoff rating for each individual application.
 1. Water Control Valves: Equal percentage characteristics with rangeability of 50 to 1, and maximum full flow pressure drop of 4 PSIG.
 2. Single Seated Valves: Cage type trim, providing seating and guiding surfaces for plug on "top and bottom" guided plugs.
 3. Double Seated Valves: Balanced plug type, with cage type trim providing seating and guiding surfaces on "top and bottom" guided plugs.
 4. Valve Trim and Stems: Polished stainless steel.
 5. Packing: Spring-loaded Teflon, self-adjusting.
 - D. Dampers: Provide automatic control dampers as indicated, with damper frames not less than formed 16 gauge galvanized steel. Provide mounting holes for enclosed duct mounting. Provide damper blades not less than formed 16 gauge galvanized steel, with maximum blade width of 8".
 1. Secure blades to 1/2" diameter zinc-plated axles using zinc-plated hardware. Seal off against spring stainless steel blade bearings. Provide blade bearings of

nylon and provide thrust bearings at each end of each blade. Construct blade linkage hardware of zinc-plated steel and brass. Submit leakage and flow characteristics plus size schedule for controlled dampers.

2. Operating Temperature Range: From -20 to 200 deg F (-29 to 93 deg C).
3. For standard applications as indicated, provide parallel or opposed blade design (as selected by the manufacturer's sizing techniques) with closed-cell neoprene edging.
4. For low leakage applications as indicated, provide parallel or opposed blade design (as selected by manufacturer's sizing techniques) with inflatable steel blade edging, or replaceable rubber seals, rated for leakage less than 10 CFM/sq. ft. of damper area, at differential pressure of 4" w.g. when damper is being held by torque of 50 inch-pounds.

E. Space Temperature Sensors:

1. Space temperature sensor shall have accuracy of +/- 0.4 deg f at 77 deg. f.
2. Sensor shall have integral diagnostic jack accessible through a tamper resistant door.
3. Sensor shall have concealed setpoint adjustment without thermometer.
4. Where indicated, sensor shall be provided with a momentary push button override to allow override of night mode.
5. Sensors shall be furnished with guards where indicated. Guard shall allow operation of sensor push button without removal.

F. Duct Sensor

1. Duct sensor shall be of the averaging or insertion type as indicated.
2. Averaging type shall be thoroughly secured to prevent element damage.
3. Accuracy shall be +/- 1.0% at 70 deg. f.

G. Immersion Sensor

1. Immersion sensor shall have an accuracy of +/- 1.0% at 70 deg. f.
2. Separate well shall be furnished.

H. Pressure Transmitters:

1. Pressure Transmitter shall sense differential pressures and convert this pressure to a proportional analog electrical signal of 0 to 5 volts, 0 to 10 volts, or 4 to 12 milliamps. The operation range shall be as indicated, or required by application, with an accuracy of 1% of full scale. The output shall be compatible with the DDC controller.

2.3 CONTROL WIRING:

- A. Provide all wiring required for temperature control systems under this section excluding power feeder wiring.
- B. Provide conduit for all control wiring.
- C. All wiring and installation shall be in accordance with the electrical specifications.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF CONTROL SYSTEMS:

- A. General: Install system and materials in accordance with manufacturer's instructions, roughing-in drawings and details on drawings.

3.3 DESCRIPTION OF OPERATION:

- A. See plans.

3.4 ADJUSTING AND CLEANING:

- A. Start-Up: Start-up, test, and adjust control systems in presence of manufacturer's authorized representative. Demonstrate compliance with requirements. Replace damage or malfunctioning controls and equipment.
- B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.
- C. Final Adjustment: After completion of installation, adjust thermostats, control valves, motors and similar equipment provided as work of this section.
 - 1. Final adjustment shall be performed by specially trained personnel in direct employ of manufacturer of primary temperature control system.

3.5 CLOSEOUT PROCEDURES:

- A. Owner's Instructions: Provide services of manufacturer's technical representative to instruct Owner's personnel in operation and maintenance of control systems.

END OF SECTION

SECTION 23 11 23 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Gas pressures for systems specified in this section are limited to 5 psig.
2. Natural gas piping above grade.
3. Unions and flanges.
4. Valves.
5. Pipe hangers and supports.

B. Related Sections:

1. Drawings and general provisions of the contract, including General and Supplementary conditions and Division 01 specification sections, apply to this section and the other sections of this Division.
2. Other sections of this Division, and of other Division, may contain requirements that relate to this section.

1.2 REFERENCES

A. American National Standards Institute:

1. ANSI Z21.15 - Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves.

B. American Society of Mechanical Engineers:

1. ASME B16.3 - Malleable Iron Threaded Fittings.
2. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
3. ASME B16.33 - Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psig (sizes 1/2 - 2).
4. ASME B31.9 - Building Services Piping.
5. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

C. ASTM International:

1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
3. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
4. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).
5. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

6. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.
 7. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
- D. American Welding Society:
1. AWS D1.1 - Structural Welding Code - Steel.
- E. American Water Works Association:
1. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
- F. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 2. MSS SP 67 - Butterfly Valves.
 3. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 4. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
 5. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
 6. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- G. National Fire Protection Association:
1. NFPA 54 - National Fuel Gas Code.
- H. Underwriters Laboratories Inc.:
1. UL 842 - Valves for Flammable Fluids.

1.3 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.
- B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves, equipment.
- C. Provide pipe hangers and supports in accordance with ASME B31.9, ASTM F708, MSS SP 58, MSS SP 69, and MSS SP 89.
- D. Use plug or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

1.4 SUBMITTALS

- A. Product Data:
 1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of valves, piping system, and system components.
- B. Operation and Maintenance Data: Submit for valves and gas pressure regulators installation instructions, spare parts lists, and exploded assembly views.

1.6 QUALITY ASSURANCE

- A. Perform natural gas Work in accordance with NFPA 54.
- B. Perform work in accordance with applicable code and local gas company requirements.
- C. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.
- D. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.
- E. Furnish shutoff valves complying with ASME B16.33 or ANSI Z21.15.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation. Furnish temporary protective coating on cast iron and steel valves.

1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 COORDINATION

- A. Coordinate trenching, excavating, bedding, and backfilling of buried piping systems with other trades.

PART 2 - PRODUCTS

2.1 NATURAL GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
 - 1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M forged steel welding type.
 - 2. Cold press mechanical joint fitting shall conform to material requirements to ASTM A420 or ASME B16.3 and performance criteria ANSI/CSA LC4. Sealing elements for press fittings shall be HNBR. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer.
 - 3. Joints: Threaded for pipe 2 inch (50 mm) and smaller; welded for pipe 2-1/2 inches (65 mm) and larger.

2.2 UNIONS AND FLANGES

- A. Unions for Pipe 2 inches (50 mm) and Smaller:
 - 1. Ferrous Piping: Class 150, malleable iron, threaded.
 - 2. Copper Piping: Class 150, bronze unions with soldered brazed joints.
 - 3. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
- B. Flanges for Pipe 2-1/2 inches (65 mm) and Larger:
 - 1. Ferrous Piping: Class 150, forged steel, slip-on flanges.
 - 2. Copper Piping: Class 150, slip-on bronze flanges.
 - 3. Gaskets: 1/16 inch (1.6 mm) thick preformed neoprene gaskets.

2.3 BALL VALVES

- A. Manufacturers:
 - 1. Crane Valve, North America
 - 2. Hammond Valve
 - 3. Milwaukee Valve Company
 - 4. NIBCO, Inc.
 - 5. Stockham Valves & Fittings
- B. 1/4 inch (6 mm) to 1 inch (25 mm): MSS SP 110, Class 125, two piece, threaded ends, bronze body; chrome plated bronze ball, reinforced Teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, full port.
- C. 1-1/4 inch (32 mm) to 3 inch (76 mm): MSS SP 110, Class 125, two piece, threaded ends, bronze body, chrome plated bronze ball, reinforced Teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, conventional port.

2.4 PLUG VALVES

- A. Manufacturers:

1. DeZURIK, Unit of SPX Corp.
 2. Flow Control Equipment, Inc.
 3. Homestead Valve
- B. 2 inches (50 mm) and Smaller: MSS SP 78, Class 150, semi-steel construction, full port, and pressure lubricated, Teflon packing, threaded ends. Furnish one plug valve wrench for every ten plug-valves with minimum of one wrench.
- C. 2-1/2 inches (65 mm) and Larger: MSS SP 78, Class 150, semi-steel construction, full port, and pressure lubricated, Teflon packing, flanged ends. Furnish wrench-operated.

2.5 PIPE HANGERS AND SUPPORTS

- A. Conform to NFPA 54, ASME 31.9, ASTM F708, MSS SP 58, MSS SP 69, and MSS SP 89.
- B. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (15 to 40 mm): Carbon steel, adjustable swivel, split ring.
- C. Hangers for Pipe Sizes 2 inches (50 mm) and Larger: Carbon steel, adjustable, clevis.
- D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- E. Wall Support for Pipe 3 inches (80 mm) and Smaller: Cast iron hook.
- F. Vertical Support: Steel riser clamp.
- G. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- H. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- I. Sheet Lead: ASTM B749, 2.5 lb/sq ft 0.039 inch (0.99 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION - INSERTS

- A. Provide inserts for placement in concrete forms.

- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches (100 mm) and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install hangers and supports in accordance with ASME B31.9, ASTM F708, and MSS SP 89.
- B. Support horizontal piping hangers as scheduled.
- C. Install hangers to provide minimum 1/2 inch (13 mm) space between finished covering and adjacent work.
- D. Place hangers within 12 inches (300 mm) of each horizontal elbow.
- E. Install hangers to allow 1-1/2 inch (38 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
- F. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
- G. Where installing several pipes in parallel and at same elevation, provide multiple pipe hangers or trapeze hangers.
- H. Prime coat exposed steel hangers and supports in accordance with Division 09. Finish paint exposed steel hangers and supports in accordance with Division 09. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- I. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

3.5 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

- A. Install natural gas piping in accordance with NFPA 54.
- B. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Design locations and arrangement of piping take into consideration pipe sizing, flow direction, slope of pipe, expansion, and other design considerations. So far as practical, install piping as indicated.
 - 1. Above-Ceiling Locations: Gas piping may be installed in accessible above-ceiling spaces (subject to the approval of the authority having jurisdiction), whether or not such spaces are used as a plenum. Valves shall not be located in such spaces.

2. Prohibited Locations: Do not install gas piping in or through a circulating air duct, clothes chute, chimney or gas vent, ventilating duct, dumb waiter, or elevator shaft. This does not apply to accessible above-ceiling space specified above.
- C. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
 - D. Route piping in orderly manner and maintain gradient.
 - E. Install piping to conserve building space and not interfere with use of space.
 - F. Group piping whenever practical at common elevations.
 - G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
 - H. Sleeve pipe passing through partitions, walls and floors.
 - I. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping.
 - J. Provide clearance for installation of insulation and access to valves and fittings.
 - K. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Division 08.
 - L. Where pipe support members are welded to structural building framing, scrape, brush clean, weld, and apply one coat of zinc rich primer.
 - M. Provide support for utility meters in accordance with requirements of utility company.
 - N. Install vent piping from gas pressure reducing valves to outdoors and terminate in weatherproof hood.
 - O. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting.
 - P. Install identification on piping systems including underground piping.
 - Q. Install valves with stems upright or horizontal, not inverted.
 - R. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.
 - S. Install gas pressure regulator with independent vent full size opening on regulator and terminate outdoors or as indicated otherwise on Drawings.

3.6 TERMINAL EQUIPMENT CONNECTIONS

- A. Install gas cock upstream and within 6 feet of gas appliance. Install a union or flanged connection downstream from the gas cock to permit removal of controls.
- B. Sediment Traps: Install a tee fitting with the bottom outlet plugged or capped as close to the inlet of the gas appliance as practical. Drip leg shall be a minimum of 3 pipe diameters in length.

3.7 FIELD QUALITY CONTROL

- A. Pressure test natural gas piping in accordance with NFPA 54.
- B. Inspect, test and purge gas piping in accordance with applicable code and local gas company requirements.
- C. When pressure tests do not meet specified requirements, remove defective work, replace and retest.

3.8 SCHEDULES

- A. Minimum Pipe Hanger Spacing:

PIPE SIZE Inches (mm)	STEEL PIPE MAXIMUM HANGER SPACING Feet (m)	STEEL PIPE MINIMUM HANGER ROD DIAMETER Inches (mm)
1/2 (12)	6 (1.8)	3/8 (9)
3/4 (20)	7 (2.1)	3/8 (9)
1 (25)	7 (2.1)	3/8 (9)
1-1/4 (32)	7 (2.1)	3/8 (9)
1-1/2 (38)	9 (2.7)	3/8 (9)
2 (50)	10 (3)	3/8 (9)
2-1/2 (65)	10 (3)	1/2 (13)
3 (75)	10 (3)	1/2 (13)
4 (100)	10 (3)	5/8 (15)
5 (125)	10 (3)	5/8 (15)
6 (150)	10 (3)	3/4 (19)
8 (200)	10 (3)	3/4 (19)

NOTE: Where code requires more stringent hanger spacing, the code requirements shall prevail.

END OF SECTION

SECTION 23 31 13 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Documents:
 - 1. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and the other sections of this Division.
 - 2. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Single-wall rectangular ducts and fittings.
 - 2. Single-wall round and flat-oval ducts and fittings.
 - 3. High Efficiency Takeoffs (HETO)
 - 4. Sheet metal materials.
 - 5. Duct liner.
 - 6. Sealants and gaskets.
 - 7. Hangers and supports.

1.3 DEFINITIONS

- A. Low Velocity Ductwork: Supply, return, make-up, and exhaust ductwork systems that are sized at 2,000 FPM or lower.
- B. Medium Velocity Ductwork: Supply ductwork systems sized at greater than 2,000 FPM to 3,000 FPM.
- C. Low Pressure Ductwork: Ductwork connected to fan systems with a 2" w.c. or less dead-head rating.
- D. Medium Pressure Ductwork: Ductwork connected to fan systems with greater than 2" w.c. and less than 6" w.c. deadhead rating.
- E. High Pressure Ductwork: Ductwork connected to fan systems with 6" w.c. or greater dead-head rating.

1.4 PERFORMANCE REQUIREMENTS

- A. Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. All work shall comply with the Mechanical Codes.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 - 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND AND FLAT-OVAL 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. Wichita Sheet Metal
 - b. Lindab Inc.
 - c. McGill AirFlow LLC.
 - d. SEMCO Incorporated.
 - e. Sheet Metal Connectors, Inc.
 - f. Wesco
 - g. Kruse Corporation
- 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).
- C. 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 (1524 mm) in Diameter: Flanged.
- D. 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" with the following restrictions:
- 1. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
 - 2. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.
 - 3. Snaplock seams are not allowed on any ductwork (SMACNA RL-6A, RL-6B, RL-7, or RL-8)
- E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

2.3 HIGH EFFICIENCY TAKEOFFS (HETO)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. Wichita Sheet Metal
 - 2. Lindab, Inc.
 - 3. McGill Airflow, LLC
 - 4. SEMCO, Inc.
 - 5. Sheet Metal Connectors, Inc.
 - 6. Wesco
 - 7. Kruse Corporation
 - 8. Ductmate Industries, Inc.

- B. General Requirements: Galvanized steel, stainless steel or aluminum construction with thickness matching required ductwork construction.
- C. Construct in accordance with SMACNA HVAC Duct Construction Standards Metal and Flexible, Third Edition 2005, Chapter 4, Figure 4-6.
- D. Rectangular opening with flange and neoprene gasket; 45 degree slope on the body.
- E. Any volume dampers provided with HETO shall meet the requirements of manual volume dampers specified in this section.

2.4 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 (Z180).
 - 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. 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.
- E. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.5 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 - 2. Tape Width: Minimum 3 inches (76 mm).
 - 3. Sealant: Modified styrene acrylic.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.

7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive or negative.
9. Service: Indoor or outdoor.
10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and shall be rated for 10-inch wg (2500-Pa) static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.

3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "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:
 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round 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 (25 mm), 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 (38 mm).
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, 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 (100 mm) thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "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 (610 mm) of each elbow and within 48 inches (1200 mm) 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 (5 m).
- 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.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 9.

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

3.8 SCHEDULES

- A. Ductwork Material Schedule:

AIR SYSTEM	MATERIAL
Supply (System with Cooling Coils)	Galvanized Steel
Return and Relief	Galvanized Steel
General Exhaust	Galvanized Steel

- B. Ductwork Pressure and Leakage Class Schedule:

AIR SYSTEM	PRESSURE CLASS	SEAL CLASS	LEAKAGE CLASS	
			ROUND	RECT
Low-Pressure Supply	2 inch wg (500 Pa).	B	6	12
Return and Relief	2 inch wg (500 Pa)	B	6	12
General Exhaust	2 inch wg (500 Pa)	A	3	6

NOTE: In no case shall the duct construction class be less than the peak pressure obtainable on the fan curve at the design fan RPM, unless pressure relief devices are installed on the effected sections of ductwork.

C. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.

D. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm (5 m/s) or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm (7.6 m/s) or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

- a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm (5 m/s) or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm (7.6 m/s) or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
- b. Round Elbows, 12 Inches (305 mm) and Smaller in Diameter: Stamped or pleated.
- c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: Welded.
- d. At Contractor's option, adjustable elbows with fully sealed gores (sealed per Part 2.6 Sealant and Gaskets article) are acceptable for low velocity, round elbows 12" and smaller in diameter.

E. 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 (5 m/s) or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap, or "low loss" tee.
 - c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral, or "low loss" tee.

END OF SECTION

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section and other sections of this Division.
- B. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Backdraft and pressure relief dampers.
 - 2. Barometric relief dampers.
 - 3. Manual volume dampers.
 - 4. Fire dampers.
 - 5. Combination fire and smoke dampers.
 - 6. Duct-mounted access doors.
 - 7. Flexible connectors.
 - 8. Flexible ducts.

1.3 SUBMITTALS

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

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

1.5 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. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60 (Z180).
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and No. 4 finish for exposed ducts.
- D. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B 221 (ASTM B 221M), Alloy 6063, Temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. American Warming and Ventilating; a division of Mestek, Inc.
 - 3. Cesco Products; a division of Mestek, Inc.
 - 4. Duro Dyne Inc.
 - 5. Greenheck Fan Corporation.
 - 6. Lloyd Industries, Inc.
 - 7. Nailor Industries Inc.
 - 8. NCA Manufacturing, Inc.
 - 9. Pottorff; a division of PCI Industries, Inc.
 - 10. Ruskin Company.
 - 11. SEMCO Incorporated.
 - 12. Vent Products Company, Inc.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 2000 fpm (10 m/s) unless noted otherwise.
- D. Maximum System Pressure: 2-inch wg (0.50 kPa) unless noted otherwise.
- E. Frame: 0.063-inch- (1.6-mm-) thick extruded aluminum, with welded corners and mounting flange.
- F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch (150-mm) width, 0.050-inch- (1.2-mm-) thick aluminum sheet with sealed edges.
- G. Blade Action: Parallel.

- H. Blade Seals: Neoprene, mechanically locked.
- I. Blade Axles:
 - 1. Material: Galvanized steel.
 - 2. Diameter: 0.20 inch (5 mm).
- J. Tie Bars and Brackets: Galvanized steel.
- K. Return Spring: Adjustable tension.
- L. Bearings: Steel ball.
- M. Accessories:
 - 1. Adjustment device to permit setting for varying differential static pressure.
 - 2. Counterweights and spring-assist kits for vertical airflow installations.
 - 3. 90 degree stops.

2.3 BAROMETRIC RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. American Warming and Ventilating; a division of Mestek, Inc.
 - 3. Cesco Products; a division of Mestek, Inc.
 - 4. Duro Dyne Inc.
 - 5. Greenheck Fan Corporation.
 - 6. Lloyd Industries, Inc.
 - 7. Nailor Industries Inc.
 - 8. NCA Manufacturing, Inc.
 - 9. Pottorff; a division of PCI Industries, Inc.
 - 10. Ruskin Company.
 - 11. SEMCO Incorporated.
 - 12. Vent Products Company, Inc.
- B. Suitable for horizontal or vertical mounting.
- C. Maximum Air Velocity: 2000 fpm (10 m/s) unless noted otherwise.
- D. Maximum System Pressure: 2-inch wg (0.5 kPa) unless noted otherwise.
- E. Frame: 0.063-inch- (1.6-mm-) thick extruded aluminum, with welded corners and mounting flange.
- F. Blades:
 - 1. Multiple, 0.050-inch- (1.2-mm-) thick aluminum sheet.
 - 2. Maximum Width: 6 inches (150 mm).
 - 3. Action: Parallel.
 - 4. Balance: Gravity.
 - 5. Eccentrically pivoted.

- G. Blade Seals: Neoprene.
- H. Blade Axles: Galvanized steel.
- I. Tie Bars and Brackets:
 - 1. Material: Galvanized steel.
 - 2. Rattle free with 90-degree stop.
- J. Return Spring: Adjustable tension.
- K. Bearings: Stainless steel or Bronze.
- L. Accessories:
 - 1. Adjustment device to permit setting for varying differential static pressures.

2.4 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers (Under 1500 FPM Velocity):
 - 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. METALAIRE, Inc.
 - f. Nailor Industries Inc.
 - g. Pottorff; a division of PCI Industries, Inc.
 - h. Ruskin Company.
 - i. Vent Products Company, Inc.
 - 2. Standard leakage rating, with linkage outside airstream.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:
 - a. Round Dampers: Galvanized steel, 0.040 inch (1.02 mm) thick (20 gauge), 7" minimum length, with rolled stiffener beads.
 - b. Rectangular Dampers: Galvanized steel with mitered and welded corners.
 - 1) Dampers up to 36" wide x up to 12" High: 0.034 inch (0.86 mm) thick (22 gauge), 3" minimum width with center "V" groove for reinforcement.
 - 2) Dampers over 36" wide or over 12" High: 0.052 inch (1.32 mm) thick (18 gauge), 5" x 1" minimum hat shaped channels with corner braces.
 - 3) For Dampers Over 48" Wide or Over 48" High: 0.064 inch (1.62 mm) thick (16 gauge), 5" x 1" minimum hat shaped channels with corner braces.
 - 5. Blades:

- a. Round Dampers: Galvanized Steel.
 - 1) Dampers up to 16" Diameter: 0.040 inch (1.02 mm) thick (20 gauge) single blade.
 - 2) Dampers Above 16" up to 24" Diameter: 0.064 inch (1.62 mm) thick (16 gauge) minimum single blade, or two sandwiched 20 gauge blades.
 - 3) For Dampers Above 24" Diameter: Utilize multiple blade rectangular dampers as specified below with field fabricated square to round transitions.

- b. Rectangular Dampers: Galvanized Steel.
 - 1) Dampers up to 36" Wide x Up to 12" High: 0.034 inch (0.86 mm) thick (22 gauge) minimum single blade.
 - 2) Dampers Over 36" Wide or Over 12" High: 0.052 inch (1.32 mm) thick (18 gauge) minimum opposed blades with 8" maximum width and reinforcement grooves or stiffeners.
 - 3) Dampers Over 48" Wide or over 48" High: 0.064 inch (1.62 mm) thick (16 gauge) minimum opposed blades with 8" maximum width and reinforcement grooves or stiffeners.

6. Blade Axles: Cadmium plated steel.

- a. Round Dampers Up to 16" Diameter or Rectangular Dampers up to 36" Wide x 12" High: 3/8 minimum square axle shaft, full width, extending through frame. Dampers 12" and smaller may utilize separate axles at each end of blade in lieu of full width.
- b. Round Dampers Over 16" diameter and Rectangular Dampers Over 36" Wide or 12" High: 1/2" minimum square or hex axle shaft(s), full width, extending through frame.

7. Bearings:

- a. Molded synthetic or oil-impregnated bronze.
- b. Bearings at both ends of operating shaft.

8. Locking Quadrants: 16 gauge zinc plated steel with wing nut on handle away from the shaft. Provide with 1 1/2" stand-off for external insulation.

9. Tie Bars and Brackets: Galvanized steel.

B. Low-Leakage, 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. METALAIRE, Inc.
 - f. Nailor Industries Inc.

- g. Pottorff; a division of PCI Industries, Inc.
 - h. Ruskin Company.
 - i. Vent Products Company, Inc.
2. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
 3. Suitable for horizontal or vertical applications.
 4. Frames:
 - a. Galvanized-steel channels, 0.064 inch (1.62 mm) thick.
 - 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, roll-formed steel, 0.064 inch (1.62 mm) thick.
 6. Blade Axles: Cadmium plated steel.
 7. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 8. Blade Seals: Neoprene.
 9. Jamb Seals: Cambered stainless steel.
 10. Tie Bars and Brackets: Galvanized steel.
 11. Locking Quadrants: 16 gauge zinc plated steel with wing nut on handle away from the shaft. Provide with 1 1/2" stand-off for external insulation.

2.5 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Air Balance Inc.; a division of Mestek, Inc.
 2. Cesco Products; a division of Mestek, Inc.
 3. Greenheck Fan Corporation.
 4. McGill AirFlow LLC.
 5. METALAIRE, Inc.
 6. Nailor Industries Inc.
 7. Pottorff; a division of PCI Industries, Inc.
 8. Prefco; Perfect Air Control, Inc.
 9. Ruskin Company.
 10. Vent Products Company, Inc.
 11. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

- B. Type: Dynamic rated and labeled according to UL 555 by an NRTL. Static rated fire dampers are not acceptable.
- C. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 4000-fpm (20-m/s) velocity.
 - 1. Clamps – Sizes 3 through 18 inches:
 - a. Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action.
 - b. Plenum rated nylon strap with minimum tensile strength of 175 lbs.
- D. Fire Rating: 1-1/2 and 3 hours.
- E. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
 - 1. Minimum Thickness: 0.052 inch (1.3 mm) thick, and of length to suit application.
 - 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165 deg F (74 deg C) rated, fusible links.

2.6 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Cesco Products; a division of Mestek, Inc.
 - 3. Greenheck Fan Corporation.
 - 4. Nailor Industries Inc.
 - 5. Ruskin Company.
- B. Type: Dynamic rated and labeled according to UL 555 and UL 555S by an NRTL for dynamic operation. Static rated dampers are not acceptable.
- C. Rated pressure and velocity to exceed design conditions.

1. In low velocity systems ($\leq 1,800$ fpm), the minimum rated velocity shall be 2,000 fpm, with a minimum 2.0" w.c. close-off, but in no case shall the qualified close of pressure be less than 1.2 times the dead-head pressure of the fan.
 2. In medium velocity systems (1,801 to 2,800 fpm), the minimum rated velocity shall be 3,000 fpm, with a minimum 4.0" w.c. close-off, but in no case shall the qualified close off pressure be less than 1.2 times the dead-head pressure of the fan. Damper blades shall be airfoil design.
 3. In high velocity systems ($> 2,800$ fpm), the minimum rated velocity shall be 4,000 fpm, with a minimum 6.0" w.c. close-off, but in no case shall the qualified close off pressure be less than 1.2 times the dead-head pressure of the fan, nor the qualified velocity be less than 1.1 times the design velocity. Damper blades shall be airfoil design.
- D. Fire Rating: 1-1/2 and 3 hours.
- E. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.
- F. Frame: Multiple-blade type; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.
- G. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.
- H. Leakage: Class II for low velocity applications (≤ 1800 FPM) and Class I for medium or high velocity applications.
- I. Rated pressure and velocity to exceed design airflow conditions.
- J. Mounting Sleeve: Factory-installed, 0.052-inch- (1.3-mm) thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone caulking.
- K. Damper Motors: Two-position action, unless noted to have modulating action. Automatic reset after system test or power failure.
- L. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "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.
 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size to meet UL 555 and 555S.
 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).

6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque to meet UL 555 and 555S.

M. Accessories:

1. Auxiliary switches for position indication when smoke dampers are part of an engineered smoke control system.

2.7 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. Flexmaster U.S.A., Inc.
5. Greenheck Fan Corporation.
6. McGill AirFlow LLC.
7. Nailor Industries Inc.
8. Pottorff; a division of PCI Industries, Inc.
9. Ventfabrics, Inc.
10. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Panels - Round Duct."

1. Door:

- a. Double wall, rectangular.
- b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
- c. Vision panel.
- d. Hinges and Latches: 1-by-1-inch (25-by-25-mm) 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 (300 mm) Square: No hinges and two sash locks.
- b. Access Doors up to 18 Inches (460 mm) Square: Two hinges and two sash locks.
- c. Access Doors up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches with outside and inside handles.
- d. Access Doors Larger Than 24 by 48 Inches (600 by 1200 mm): Four hinges and two compression latches with outside and inside handles.

C. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Factory set to prevent over pressurization of protected duct, based on specified pressure class. Set pressure relief device to limit maximum pressure to 125% of rated pressure class.
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

2.8 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. Ventfabrics, Inc.
 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches (89 mm) wide attached to 2 strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
 2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
 3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 1. Minimum Weight: 24 oz./sq. yd. (810 g/sq. m).
 2. Minimum Tensile Strength: 500 lbf/inch (88 N/mm) in the warp and 440 lbf/inch (77 N/mm) in the filling.
 3. Service Temperature: Minus 50 to plus 250 deg F (Minus 45 to plus 121 deg C).

2.9 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Thermaflex
 2. Flexmaster U.S.A., Inc.
 3. McGill AirFlow LLC.
 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, woven and coated fiberglass supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
1. Pressure Rating: 10-inch wg (2500 Pa) positive and 2.0-inch wg (500 Pa) negative.
 2. Maximum Air Velocity: 4000 fpm (20 m/s).
 3. Temperature Range: Minus 20 to plus 250 deg F (Minus 29 to plus 121 deg C).
 4. Insulation R-value: R-6.0 per ASTM C-518.
- C. Flexible Duct Connectors:
1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated. Dampers are not allowed in kitchen hood grease ducts.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 1. Install steel volume dampers in steel ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install fire and smoke dampers according to UL listing.
- G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 1. 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.

2. Elsewhere as indicated.
- H. Install access doors with swing against duct static pressure.
- I. Access Door Sizes:
1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
 2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
 3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
 4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
 5. Body Access: 25 by 14 inches (635 by 355 mm).
 6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).
- J. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- K. Install flexible connectors to connect ducts to equipment.
- L. For fans developing static pressures of 5-inch wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- M. Connect terminal units to supply ducts utilizing rigid ducts. Flexible ducts are not allowed on inlet connections to terminal units.
- N. Connect supply diffusers to ducts directly or with maximum 72-inch (1800-mm) lengths of flexible duct clamped or strapped in place.
- O. Connect flexible ducts to metal ducts with draw bands. Flexible ducts are not allowed on negative pressure ductwork, in exposed areas, or on inlets to terminal units.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 4. Inspect turning vanes for proper and secure installation.

END OF SECTION

SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section and the other sections of this Division.
- B. Other sections of this Division, and of other Divisions, may contain requirements that relate to this section.

1.2 SUMMARY

- A. Extent of outlets and inlets work is indicated by drawings and schedules, and by requirements of this section.
- B. Types of outlets and inlets required for project include the following:
 - 1. Ceiling air diffusers.
 - 2. Wall and floor registers and grilles.
- C. Refer to other Division 23 sections for ductwork and duct accessories required in conjunction with air outlets and inlets; not work of this section.
- D. Refer to other Division 23 sections for balancing of air outlets and inlets; not work of this section.

1.3 QUALITY ASSURANCE:

- A. Manufacturers Qualifications: Firms regularly engaged in manufacture of outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. ARI Compliance: Test and rate air outlets and inlets in accordance with ARI 650 "Standard for Air Outlets and Inlets".
 - 2. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".
 - 3. ADC Compliance: Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".
 - 4. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".
- C. Performance Requirements:

1. Noise Criterion (NC): NC rating for all air inlets and outlets shall be NC 30 maximum, when rated in accordance with ASHRAE 70-01 with room absorption of 10dB, re 10⁻¹² watts.

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's data on outlets and inlets including the following:
 1. Schedule of air outlets and inlets indicating drawing designation, type, and number furnished, model number, size, and accessories furnished.
 2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.
 3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses, throw and drop, and noise criteria ratings. Indicate selections on data.
- B. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 1.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver air outlets and inlets wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.
- B. Store outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 CEILING AIR DIFFUSERS:

- A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.
- B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.
- C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.
- D. Standard color of diffusers is white, unless noted otherwise. Where diffusers are installed in hard ceilings or soffits, paint to match adjacent surface.

- E. Types: Provide ceiling diffusers of type, capacity, and with accessories and finishes as listed on diffuser schedule. Use all steel diffusers where fire dampers are required. Opposed blade dampers shall be provided only if specifically indicated on the drawings.
- F. Manufacturer: Subject to compliance with requirements, provide diffusers of one of the following:
 - 1. Krueger Mfg. Co.
 - 2. Titus Products Div.; Philips Industries, Inc.
 - 3. Air Guide
 - 4. Price
 - 5. Nailor
 - 6. Carnes

2.2 WALL AND FLOOR REGISTER AND GRILLES:

- A. General: Except as otherwise indicated, provide manufacturer's standard wall registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.
- B. Performance: Provide wall or floor registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.
- C. Wall or Floor Compatibility: Provide registers and grilles with border styles that are compatible with adjacent wall or floor systems and that are specifically manufactured to fit into wall or floor construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of wall construction which will contain each type of wall register and grille.
- D. Standard color of grilles is white, unless noted otherwise. Where grilles are installed in hard ceilings, sidewalls, or soffits, paint to match adjacent surface.
- E. Types: Provide wall or floor registers and grilles of type, capacity, and with accessories and finishes as listed on register and grille schedule. Provide all steel registers where fire dampers are required. Opposed blade dampers shall be provided only if specifically indicated on the drawings.
- F. Manufacturer: Subject to compliance with requirements, provide registers and grilles of one of the following:
 - 1. Titus Products Div.; Phillips Industries, Inc.
 - 2. Krueger
 - 3. Air Guide
 - 4. Price
 - 5. Nailor
 - 6. Carnes

2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 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.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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. Locate units so that ceiling grid is not cut. 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.
- D. Install balancing damper with locking quadrant in runout to supply diffusers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 81 06 - PACKAGED HEATING AND COOLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this Section.
- B. Division-23 Basic Mechanical Materials and Methods sections apply to work of this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Rooftop packaged units

1.3 REFERENCES

- A. Air-Conditioning and Refrigeration Institute (ARI):
 - 1. 210 - Standard for Unitary Air-Conditioning Equipment
 - 2. 360 - Commercial and Industrial Unitary Air-Conditioning Equipment
- B. American Society for Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - 1. 15 - Safety Code For Mechanical Refrigeration
- C. American Society of Mechanical Engineers (ASME):
 - 1. ASME Boiler and Pressure Vessel Code
- D. National Fire Protection Association (NFPA)
 - 1. 34 - Standard for Dipping and Coating Processes Using Flammable or Combustible Liquids
 - 2. 90A - Standard for Installation of Air Conditioning and Ventilating Systems
- E. Underwriters Laboratories, Inc. (UL)
 - 1. 303 - Refrigeration and Air-Conditioning Condensing and Compressor Units

1.4 SUBMITTALS

- A. Division 1: Conform to the requirements of Division 1, "Submittals."
- B. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights, furnished specialties and accessories; and installation and start-up instructions.

- C. Wiring Diagrams: Submit the following diagrams.
 - 1. Submit manufacturer's electrical requirements for power supply wiring.
 - 2. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring.
 - 3. Clearly differentiate between portions of wiring that are factory-installed and field-installed.
- D. Maintenance Data: Submit maintenance data and parts list for each packaged air-conditioning unit. Include this data and product data in maintenance manual, in accordance with requirements of Division 1.

1.5 QUALITY ASSURANCE

- A. Provide capacity ratings in accordance with the following ARI Standards:
 - 1. ARI 210 for units 10 tons and smaller.
 - 2. ARI 360 for units 10 tons and larger.
- B. Construct refrigerating system in accordance with ASHRAE 15.
- C. Provide packaged heating and cooling units which are designed, manufactured, and labeled in conformance with UL 303. In lieu of UL, testing and listing by Electrical Testing Laboratories (ETL) will be acceptable.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Handling: Handle packaged units and components carefully to prevent damage, denting and scoring. Do not install damaged packaged air-conditioning units or components; replace with new.
- B. Storage: Store packaged units and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.
- C. Rigging: Comply with manufacturer's rigging and installation instructions for unloading packaged units, and moving them to final location.

PART 2 - PRODUCTS

2.1 ROOFTOP PACKAGED UNITS

- A. Manufacturers:
 - 1. AAON
 - 2. Trane
 - 3. Valent
 - 4. McQuay
 - 5. Pre-approved equal.
- B. General: Provide factory-assembled and tested packaged rooftop air-conditioning units as indicated, designed for roof or slab mounting, consisting of casing, compressors,

evaporator, condenser, heating section, fans, filters and unit controls. Provide capacities and electrical characteristics as scheduled.

- C. Casings: Provide casings constructed of minimum 18 gauge galvanized steel panels on welded steel frames.
 - 1. Factory paint with weather resistant baked enamel finish.
 - 2. Provide internal insulation minimum 1-inch thick 1-1/2-pound density neoprene coated fiberglass.
 - 3. Provide hinged access doors with handle latches for access to all serviceable components.
 - 4. Provide knock outs for electrical and piping connections.

- D. Compressors: Provide scroll type compressors.
 - 1. Mount compressors on vibration isolators.
 - 2. Provide internal overload protection.
 - 3. Provide five year unconditional parts and labor warranty.
 - 4. Provide digital scroll variable, or multi-stage compressors where scheduled for variable modulating control.

- E. Evaporator Coil: Provide coils with internally grooved copper tubing, mechanically bonded aluminum fins. Factory test at 150 percent of maximum working pressure.

- F. Refrigeration Circuit: Provide a complete and operative refrigeration system including thermal expansion valves or capillary metering devices and filter driers.
 - 1. Provide service valves on suction and liquid lines for pressure gauge attachment.
 - 2. Provide refrigerant and oil charges required for operation.
 - 3. Provide independent refrigerant circuits for each compressor.
 - 4. Insulate all suction lines where condensate is not collected in drain pans.
 - 5. Filter/Dryers to protect system from dirt and moisture.
 - 6. Automatic reset low pressure safety control.
 - 7. Manual reset high pressure safety control.
 - 8. Utilize R410A refrigerant.

- G. Air Cooled Condensers: Provide air cooled condensers as follows:
 - 1. Provide internally grooved copper tubing, condenser coils mechanically bonded aluminum fins. Factory test at 150 percent maximum working pressure.
 - 2. Provide propeller fans with aluminum or galvanized steel blades, statically and dynamically balanced, direct driven with permanently lubricated fan and motor bearings. Provide motor thermal overload protection.
 - 3. Provide louvered coil guards or hail screen over coils.

- H. Hot-Gas Reheat Refrigerant Coil (Where Scheduled):
 - 1. Aluminum plate fin and seamless copper tube in steel casing with equalizing-type distributor.
 - 2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.

- I. Evaporator Fans: Provide double-width, double-inlet, forward-curved centrifugal fans constructed of galvanized steel or aluminum with permanently lubricated fan and motor bearings and statically and dynamically balanced fan wheel.
 - 1. Provide 1,800 rpm (max) motor mounted on NEMA adjustable base and motor thermal overload protection.
 - 2. Provide adjustable V-belt drives.

- J. Multiple Speed Evaporator Fan (Where Scheduled):
 - 1. Evaporator fan shall be capable of operating at multiple speeds for enhanced humidity control and reduced temperature variation in the heating mode. Multiple speed operation can be achieved through the use of a factory mounted variable frequency drive (VFD) or electronically commutated motor (ECM). The evaporator fan shall be direct-drive, forward curved, centrifugal wheel. Motor shall have thermal overload protection & permanently lubricated motor bearings. Motor/blower assembly isolated from unit with rubber mounts. The blower assembly shall slide out for ease of service.
 - a. After unit startup, supply fan speed shall be adjusted to provide design of air flow with installed duct work and filtration.
 - 1) Units using programmable ECM type motor shall be set for required airflow based on factory recommendations.
 - 2) Units using VFD shall have airflow and speed set by certified air balance contractor.
 - b. During the cooling mode the supply airflow shall be staged to minimize zone temperature variation, improve humidity control and lower unit sound levels.

- K. Drain Pans: Provide stainless steel or minimum 16 gauge galvanized steel, zinc chromate treated and insulated conforming to NFPA 90A. Provide threaded drain connection.

- L. Filters: Provide 2-inch thick pleated media filters installed in integral filter rack located in the return airstream. Filters 30% efficient equal to Farr 30/30. Provide 2 complete sets.

- M. Controls: Provide factory installed and wired controls with terminal strip mounted in watertight control box. Provide connections for remote thermostat. Units shall have single point connection for electrical power supply and shall include individual overload protection for each motor.
 - 1. Provide low refrigerant pressure cutout switches for each compressor. Provide high pressure cutout or internal relief for each compressor. Provide freeze thermostat to protect evaporator coil.
 - 2. Provide compressor start time delay to automatically prevent restart for at least 5 minutes after shutdown.
 - 3. Provide crankcase heaters.
 - 4. Provide outside air economizer on all units to provide capability to use up to 100 percent outside air for cooling. Economizer shall have relief damper, modulating return air damper and low leakage outside air damper controlled by a mixed air

- thermostat through an adjustable outdoor air changeover thermostat. Outside air damper shall have minimum position adjustment and shall have intake louver or rain hood.
5. Provide low ambient control to permit operation down to 40 degrees F. ambient air temperature minimum or as scheduled on plans.
 6. Microprocessor based controls shall include an interface to the specified DDC controls.
- N. Gas Heaters: Provide single, two stage, or modulating (as scheduled on plans) indirect fired gas furnace, UL or ETL listed, with automatic spark ignition suitable for natural gas operation as indicated.
1. Provide aluminized steel (or stainless steel heat exchanger where scheduled or required).
 2. Provide automatic combination main gas valve and pressure regulator, high limit thermostat flame sensor and automatic relight system.
 3. Provide AGA design certified equipment.
 4. Provide ten (10) year minimum non-prorated warranty on the heat exchanger.
 5. Any modulating heat units shall have a stainless steel heat exchanger.
- O. Outside Air Dampers: Provide low leakage dampers with 1/2-inch mesh screen and intake louver or rain hood. Dampers shall automatically open when the unit starts and close when the unit stops.
- P. Provide factory roof curb on all units.
- Q. Provide single power connection to unit with control circuit transformer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install packaged units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
- B. Electrical Wiring: Install electrical devices furnished by manufacturer but not factory-mounted.
- C. Ductwork: Connect supply and return ducts to unit with flexible duct connections. Provide transitions to exactly match unit duct connection size.
- D. Roof Mounted Units: Install units in accordance with National Roofing Contractors Association (NRCA) Installation Recommendations.
1. Provide manufacturers roof curbs.
- E. Drain Piping: Connect unit drain to nearest indirect waste connection. Provide trap at drain pan; construct at least 1-inch deeper than fan pressure in inches of water.

- F. Start-up packaged units in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- G. Gas Piping: Refer to Division 23 section for piping. Connect gas piping to unit gas train with shutoff cock and drip leg. Conform to NFPA 34.

END OF SECTION

SECTION 26 05 00 – COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 GENERAL CONDITIONS:

- A. The General Conditions, Supplementary General Conditions, General Requirements, and Special Conditions shall be and are hereby made a part of this Section of the specifications.
- B. In case of conflicts between the electrical drawings and Division 26 of these specifications, the more stringent requirements shall govern. In all cases, notify the Engineer for direction.
- C. The requirements of COMMON WORK RESULTS FOR ELECTRICAL establish minimum requirements, apply to, and are hereby made a part of all sections of Division 26, 27, and 28 of this specification.
- D. The Contractor shall be responsible for excavation of all earth, soil, and rock conditions at the site. Review the elevations and soil boring logs and include all associated costs.

1.2 DESCRIPTION:

- A. The electrical work shall include all labor, materials, tools, transportation, equipment, services and facilities, required for the complete, proper and substantial installation of all electrical work shown on the plans, and/or outlined in these specifications. The installation shall include all materials, appliances, and apparatus not specifically mentioned herein or noted on the drawings but which are necessary to make a complete working installation of all electrical systems.
- B. All of the electrical related work required for this project (unless specified otherwise) is a part of the Electrical Contract price but is not necessarily specified under this division of the specifications or shown on the electrical drawings. Therefore, all divisions of the specifications and all drawings shall be consulted.
- C. The floor plan drawings are schematic only and are not intended to show the exact routing of raceway systems unless dimensions are noted on the drawings. Final routing will be governed by field conditions (structural members, mechanical equipment, ductwork, etc.) and shall be determined by the Contractor and approved by the Architect. Any changes in routing shall not change the design of the raceway system.
- D. The floor plan drawings showing device and equipment locations are schematic only and are not intended to show exact locations unless dimensions are noted on the drawings. The Contractor shall review all contract drawings that may affect the location of devices and equipment to avoid possible interference and permit full coordination of all work. The right to make any reasonable change in location within 6'-0", is reserved by the Architect up until the time of rough-in at no extra cost.
- E. Furnish and install electrical wiring, systems, equipment and accessories in accordance with the specifications and drawings. Capacities and ratings of transformers, cable, switchgear, panelboards, motor control, and other items, arrangement for specified items in general are shown on drawings.

- F. Provide all required temporary building power and lighting. Remove when finished. Installation of temporary power and lighting shall comply with N.E.C. and OSHA requirements.
- G. Ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways accordingly sized.

1.3 MINIMUM REQUIREMENTS:

- A. Codes Rules and Regulations: Execute all work under ADA, the latest rules and regulations of the National Electrical Code Standard of the National Board of Fire Underwriters, the National Fire Protection Association, and with all laws, regulations and ordinances of the County, State, City, and the Utility Company.
- B. Codes shall govern in case of any direct conflict between codes, plans and specifications; except when plans and specifications require higher standards than those required by code. Variance from the plan and specifications made to comply with code must be approved by the Architect. If approved they shall be made with no increased cost to the Owner.

1.4 STANDARDS:

- A. All material and equipment shall be listed, labeled or certified by Underwriters Laboratories, Inc., where such standards have been established. Equipment and material which are not covered by UL Standards will be accepted provided equipment and material is listed, labeled, certified or otherwise determined to meet safety requirements of a nationally recognized testing laboratory. Equipment of a class which no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as NEMA, or ANSI. Evidence of compliance shall include certified test reports and definitive shop drawings.
- B. Definitions:
 - 1. Certified: Equipment is "certified" if:
 - a. Equipment has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards, or to be safe for use in a specified manner.
 - b. Production is periodically inspected by a nationally recognized testing laboratory.
 - c. It bears a label, tag, or other record of certification.
 - 2. Nationally recognized testing laboratory: A testing laboratory which is approved, in accordance with OSHA regulations, by the Secretary of Labor.

1.5 QUALIFICATIONS (PRODUCTS AND SERVICES):

- A. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.
- B. Product Qualification:

1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
 2. The Engineer reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.
- C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will respond within two hours of receipt of notification that service is needed. Submit name and address of service organization.

1.6 MANUFACTURED PRODUCTS:

- A. Materials and equipment furnished shall be new, of best quality and design, free from defects, of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts should be available. All items used on this project shall be free of asbestos, PCB, and mercury material.
- B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
1. Components of an assembled unit need not be products of the same manufacturer unless indicated otherwise.
 2. Manufacturers of equipment assemblies, which include components made by others, shall be completely responsible for the final assembled unit.
 3. Components shall be compatible with each other and with the total assembly for the intended service.
 4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory and Field wiring shall be identified on the equipment being furnished and on all wiring diagrams.
- E. When Factory Testing is Specified:
1. The Engineer shall have the option of witnessing factory tests. The Contractor shall notify the Engineer a minimum of 15 working days prior to the manufacturer making the factory tests.
 2. Four copies of certified test reports containing all test data shall be furnished to the Engineer prior to final inspection and not more than 90 days after completion of the tests.
 3. When equipment fails to meet factory test and reinspection is required, the Contractor shall be liable for all additional expenses, including expenses of the Engineer.

1.7 EQUIPMENT PROTECTION:

- A. Equipment and material shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain.
- B. During installation, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter and be vacuum cleaned both inside and outside before testing, operating and painting.

- C. Damaged equipment shall be, as determined by the Engineer, placed in satisfactory operating condition or be returned to the source of supply for repair or replacement.
- D. Painted surfaces shall be protected with factory installed removable heavy Kraft paper, sheet vinyl or equal.
- E. Damaged paint on equipment and materials shall be restored to the original quality of paint and workmanship as used by the manufacturer so repaired area is not obvious.

1.8 GENERAL WORK REQUIREMENTS:

- A. Arrange, phase and perform work to assure electrical service both temporary and permanent for buildings at all times.
- B. Coordinate location of equipment and conduit with other trades to minimize interferences.
- C. Examination of Site:
 - 1. Visit the site, inspect the existing conditions and check the drawings and specifications so as to be fully informed of the requirements for completion of the work.
 - 2. Lack of such information shall not justify an extra to the contract price.
- D. Permits:
 - 1. Obtain and pay for all licenses and permits, fees, inspection and certificates required for the execution of this work.
 - 2. Pay fees and charges for use of property.
 - 3. Deliver permits and certificates to the Architect to be transmitted to the Owner.
- E. Responsibility:
 - 1. This Contractor will be held responsible for any and all damage to any part of the building or to the work of other contractors, as may be caused through this contractor's operation.
 - 2. Any mutilation of building finishes or equipment initiated by electrical construction shall be properly corrected by the respective finishing contractor and paid for by the Electrical Contractor.
 - 3. The operation of the temporary power and the permanent electrical system shall be the responsibility of the Contractor until acceptance of the building by the Owner.
- F. Work to be done by General Contractor:
 - 1. Build in all openings, sleeves, chases, etc., for conduit and equipment as established, furnished and set by this Contractor. The General Contractor shall seal or grout all openings after this Contractor has installed the conduits.
 - 2. Build in bolts, brackets, hangers etc., for work established, furnished and set by this Contractor.
 - 3. All concrete work required for equipment furnished and set by this Contractor including clean up pads under electrical gear, fixture bases, transformer bases, etc.
 - 4. Painting: All painting of electrical equipment installed in finished areas shall be done by the General Contractor. Painting will not be required on receptacles,

switches, circuit breakers etc. All fixtures and exterior poles specified to be factory-primed shall be painted by General Contractor. Paint all wiremold, exposed conduit and equipment, etc., to match final wall colors.

5. Provide fireproofing above fixtures located in fire rated ceilings per U.L. requirements.
6. Pay all utility costs for operation of electrical system during construction until acceptance of building by the Owner.

G. Work done by the Mechanical Contractor:

1. The Mechanical Contractor shall furnish wiring diagrams and temperature control drawings of all equipment furnished to the Electrical Contractor. (Catalog information is unacceptable, provide point to point drawings.)
2. The Mechanical Contractor shall furnish and install all control equipment requiring connections to air, water, steam, etc., such as pneumatic electric relays, remote bulb temperature controls, solenoid valves, aquastats and pressure controls.
3. The Mechanical Contractor shall reimburse the Electrical Contractor for any changes in system design i.e.; control or equipment which affects the Electrical Contractor. Also refer to equipment connections, controls and instrumentation in 260500.

H. Workmanship and Coordination:

1. Make installation substantially as shown on the plans.
2. Make alterations in location of apparatus or conduit as may be required to conform to building construction without extra charge.
3. Mechanical equipment service clearances and electrical apparatus service clearances as specified in their respective manufacturer's product data shall be maintained free from conduit.
4. Cooperate with other trades in their installation of work.
5. Complete the installation in a workmanlike manner, completely connected and ready to give proper and continuous service.
6. Use only experienced licensed electricians.

I. Cutting and Patching:

1. Notify the General Contractor in ample time, of the location of all chases, sleeves, and other openings required in connection with the work of this contract.
2. Cutting and patching made necessary because of failure to comply with the above shall be done by the General Contractor at the expense of the Electrical Contractor.
3. When it is necessary for the Electrical Contractor to cut building materials, it shall be done in a neat and workmanlike manner meeting with the approval of the Architect.
4. Holes through concrete shall be carefully drilled with a "Concrete Termite" drill. A Star Drill or Air Hammer will not be permitted. Structural members shall not be cut without approval from the Architect.
5. Any penetrations thru the roof shall be made with "Stoneman" 900 Series flashing connections as manufactured by Elmdor/Stoneman, City of Industry, California, or as approved by the Architect.
6. Any penetrations made in exterior or basement foundation walls shall be sealed with Thunderline "Link-Seal" connections, as manufactured by Thunderline Corporation, Wayne, Michigan.

J. Manufacturer's Instructions:

1. Apply, install, connect, erect, use, clean, and condition articles, materials and equipment as directed by the manufacturer.

1.9 EQUIPMENT INSTALLATION AND REQUIREMENTS:

A. Equipment location shall be as close as practical to locations shown on the drawings.

B. Working spaces shall not be less than specified in the National Electrical Code for all voltages specified.

C. Inaccessible Equipment:

1. Where the Engineer determines that the Contractor has installed equipment without proper clearances or not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled as directed at no additional cost to the Owner.

- a. Install access panels as approved by the Architect to provide access to all equipment, J-boxes and outlets located in non-accessible spaces. Panels shall be flush locking type with a fire rating equal to the ceiling system.

2. "Conveniently accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, pumps, belt guards, transformers, piping, and ductwork. Outlet and box covers shall be removable by using regular length (8") screw drivers.

D. Distribution Equipment:

1. All items of Electrical Distribution Equipment (switchboards - panelboards - disconnects) shall be of one manufacturer, unless specifically noted on the drawings, in the specifications, or approved by the Engineer. Intermixing of distribution equipment by different manufacturers will not be permitted.
2. Equipment layouts on the drawings are based on one manufacturer. Verify all actual equipment sizes with equipment manufacturer prior to bidding.
3. If layout changes are required due to differing electrical manufacturer's equipment size, they must be submitted to and approved by the Engineer. National Electric Code working clearances must be maintained at all times. Extra remuneration will not be allowed for layout changes that differ from those shown.
4. Provide and install all steel supports as required for mounting of electrical equipment.
5. Anchor all free standing electrical equipment including switchboards, switchgear, substations, motor control centers, paralleling gear, transfer switches, transformers, etc. to the floor with plated, 1/2" diameter minimum, anchor bolts or as recommended by the manufacturer.

1.10 EQUIPMENT CONNECTIONS, CONTROLS AND INSTRUMENTATION:

A. General: The following applies to all electrical power and control connections for all equipment requiring electrical installation work provided by others.

- B. Electrical Contractor shall install and connect the following items for equipment requiring electrical power that is either furnished or specified by other Contractors and/or the Owner. Where these required items are not furnished with the equipment being connected, it shall be the Electrical Contractors responsibility to provide the necessary items including conduit, boxes and wiring.
1. Starters
 2. Variable Frequency Drives
 3. Disconnecting Devices
 4. Thermal Overload Devices
 5. Overcurrent Devices
 6. Short Circuit Protective Devices
 7. Power Factor Correction Devices
 8. Voltage Transformation Equipment
 9. Control Devices (Local and Remote)
 10. Audible and Visual Control Status Annunciation Devices
 11. Equipment Mounting Structures
 12. Additional Miscellaneous Devices
- C. In general, all major equipment will be specified to be factory prewired with only service and interconnecting wiring required at the site by the electrical contractor; however, the Electrical Contractor shall check all divisions of the specification to verify if the equipment is specified factory prewired and if not, then it shall be the responsibility of the Electrical Contractor to provide the complete wiring of the equipment in accordance with wiring diagrams provided by other contractors and/or Owner to the Electrical Contractor. All interconnecting of equipment shall be by the Electrical Contractor.
- D. The Electrical Contractor shall provide 120 volt control power supply; #12 Ga. CU. THHN/THWN in 1/2"C. minimum at all points required by controls, instrumentation and sprinkler risers. Circuit as shown on the plans or to the nearest 120 volt panel if no circuiting is indicated. Use spare 20 Amp. breakers. Each control panel shall be on a separate circuit unless otherwise indicated. If the controlled equipment is fed from the emergency system, then the control power supply must feed from the emergency system.
- E. The Contractor shall become familiar with the equipment to be furnished by the other Contractors and/or the Owner in connection with this work and include provisions for such connections and work in the Contractor's price. Extra remuneration will not be allowed for such work.
- F. Connections to all equipment have been designed from units as specified on the drawings or in the specifications. In the event equipment or control differs on approved shop drawings it shall be the responsibility of the Supplying Contractor to coordinate electrical connections to the units and reimburse Electrical Contractor for any changes in system design. These changes shall not involve additional cost to the Owner.
- G. Review all plans and specifications to verify all equipment connections that are required by mechanical and/or other contractors. Although the electrical drawings will show equipment connection requirements, it is the Electrical Contractor's responsibility to connect all equipment furnished by other Contractor's at no extra cost to the Owner, even if this equipment connection is not shown on the electrical drawings. Coordinate all required connections not shown on the electrical drawings with the Engineer.

1.11 NAMEPLATES:

- A. General: The following items shall be equipped with nameplates:
1. Disconnect switches (fused or nonfused), transformers, switchboards (including branch circuit breakers/switches), panelboards, separately mounted circuit breakers, starters, contactors, relays, junction boxes and pull boxes.
- B. Inscription: Nameplates shall adequately describe the function or use of the particular equipment involved. Nameplates for panelboards and switchboards shall include the panel designation, voltage, and phase, A.I.C. rating of the supply (see schedules, one-line diagram, and color coding). For example, "Panel A" 120/208 V, 3-Phase, 4-Wire, 10,000 A.I.C. or "50,000 AIC with 22 KA Breakers, Series with class 'J' Fuses":
1. Phase A - Black
 2. Phase B - Red
 3. Phase C - Blue
 4. Neutral - White
 5. Ground - Green
- C. The name used for a machine nameplate shall be the same as the one used on the machine's motor starter, disconnect and P.B. station nameplates. Nameplates for fused switches and panels shall also indicate fuse type and size.
1. In addition to the instructions listed above:
 - a. All panelboards and transfer switches fed from the emergency system shall be labeled "Emergency System".
 - b. All panelboards and transfer switches fed from the standby system shall be labeled "Standby System".
- D. Construction:
1. Nameplates shall be as follows:
 - a. Normal power - laminated phenolic plastic white front and back with black core.
 - b. Emergency System - laminated phenolic plastic red front and back with white core.
 - c. Standby System - laminated phenolic plastic blue front and back with white core.
 1. Lettering shall be engraved through front layer to form 1/4" characters. Nameplates shall be securely fastened to the equipment to be identified, with No. 4 Phillips, round head, cadmium plated, steel self tapping screws or nickel plated brass bolts. Motor nameplate may be nonferrous metal not less than 0.03 inches thick, die stamped. In lieu of separate plastic nameplates, engraving directly on device plates is acceptable. Letters engraved thus, shall be filled with contrasting enamel. All nameplates and their installation are part of this work. Free hand lettering will not be acceptable. Electronic dymo labeling will be allowed if lettering meets the size requirements listed above and on plan details.

1.12 MATERIALS OF APPROVED EQUAL:

- A. Where items of equipment and/or materials are specifically identified herein by a manufacturer's name, model or catalog number, and only such specific items may be used in the base bid, except as hereinafter provided.
- B. Unless requests for changes in base bid specifications are received, approved and noted by written addendum prior to the opening of bids, the successful contractor will be held to furnish specified items.
- C. After contract is awarded, changes in specifications shall be made only as defined under "Substitution of Equipment".

1.13 SUBSTITUTION OF EQUIPMENT:

- A. After execution of the contract, substitution of equipment of makes other than those specifically named in the contract documents, may be approved by the Engineer, only if the equipment named in the specifications cannot be delivered to the job in time to complete the work in proper sequence and due to conditions beyond control of the Contractor. Provide documentary proof in writing from the manufacturer that the specified equipment will not be available in time. If the Contractor is responsible for the delay, the substitution will not be approved.
- B. Requests for substitutions must be accompanied by documentary proof of equality or difference in price and delivery, if any, in form of certified quotations from suppliers of both specified and proposed equipment.

1.14 SUBMITTALS: IN ACCORDANCE WITH SECTION SAMPLES AND SHOP DRAWINGS, FURNISH THE FOLLOWING:

- A. The Engineer's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site.
- B. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Engineer to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.
- C. Submittals shall be complete and submitted together for each section. Individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assemble as a whole. Partial submittals will not be considered for approval.
 - 1. Mark the submittals, "SUBMITTED UNDER SECTION_____". Mark out all statements on sheets that do not apply otherwise. The Engineer may select options and equipment not originally specified. All options that are not marked out will be assumed that the Contractor will furnish the same.
 - 2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
 - 3. Submit each section separately.

4. Mark catalog cuts to indicate equipment, capacities, finishes, sizes, etc. Each individual item shall have its own sheet provided for approval. (Example: Separate sheets for each panelboard.)
- D. The submittals shall include the following:
1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
 2. Elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
 3. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.
 4. Quantities of materials will not be verified by the Architect or Engineer. Approval stamp on shop drawings does not constitute approval of quantities listed on shop drawings.
 5. Shop drawings:
 - a. All shop drawings shall be checked and signed by this contractor and general contractor prior to submittal to the Architect/Engineer.
 - b. Shop drawings submitted without Contractor's signatures or approval and verification will not be approved.
 - c. Shop drawings shall be submitted on devices, lighting fixtures (including distribution curves), motor starters, panelboards, disconnects, raceway systems, low-voltage systems, etc.
 6. Each sheet shall be either 8 1/2" x 11"; 8 1/2" x 13"; or 11" x 17" bond with a 5" x 3" clear area for engineer's stamp. (This area shall not be used by this contractor or the general contractor's stamp.) Larger drawings shall be able to be blue printed.
 7. Submittals for low-voltage systems (fire alarm, intercom, etc.) shall include complete riser diagrams showing all conductors and conduit sizes.
- E. Engineer's acceptance of Compliance Submittals will not relieve the Contractor from his responsibility for any deviations from the requirements of the contract documents, unless Contractor has in writing called Engineer's attention to such deviation at the time of submission and the Engineer has given written approval to the specific deviation; nor shall any acceptance by Engineer relieve Contractor from responsibility for errors or omissions in Compliance Submittals.
- F. Quantity of Submittals: See the general specification sections.

1.15 ELECTRICAL WORK COMPLETION:

- A. Before requesting final inspection the following work must be completed.
- B. Operating Instructions:
 1. The Contractor shall submit along with the shop drawings of the equipment, three (3) copies of operating instructions for all items. Instructions shall be prepared by the manufacturer of the equipment.

2. After the operating instructions have been approved by the Engineer, the Contractor shall include the three (3) copies in maintenance instructions brochures.
3. The Contractor shall also obtain all manufacturers' instructions, manuals, and one complete set of drawings and turn these over to the Architect at the completion of the project.
4. The Contractor shall keep in a safe place; all keys and special wrenches furnished with equipment under this contract and shall give same to the Architect at the completion of the project.
5. The Contractor shall prepare a complete brochure, in triplicate, covering all systems and equipment furnished and installed under his contract. Brochures shall be submitted to the Architect-Engineer for approval and delivery to the Owner. The cost of this brochure shall be included in the contract cost. Brochures shall contain the following:
 - a. Certified equipment drawings and/or catalog data clearly marked for equipment furnished as required for approval submission under detailed section of the specifications.
 - b. Complete operating and maintenance instructions for each item of equipment.
 - c. Complete part list for each equipment item.
 - d. Any special emergency operating instructions or a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to the various parts of the system.
6. Brochures shall be bound in hard backed three ring binders with an index, sub dividers and reinforced sheets.
 - a. Project name and address.
 - b. Section of work covered by brochure, i.e., "Electrical Work".
 - c. Name and address of Architect.
 - d. Name and address of Engineer.
 - e. Name and address of Contractor.
 - f. Telephone number of Contractor, including night or emergency number.
7. In addition to these written instructions, each respective Contractor shall fully and carefully instruct the Owner, or Owner's selected representatives, as to the proper operation, care and maintenance of each system and its equipment.

1.16 TESTING AND ADJUSTMENT:

- A. Record loads on each phase of all panelboards, distribution panels, switchboards, transformers and submit final readings to the Architect for records. This Contractor shall adjust equipment, instruments, gages, meters etc., as required to test and adjust these systems.
- B. Check, test, and adjust the mechanisms of all electrical equipment and adjustable parts of lighting fixtures as required for optimum performance.
- C. Perform tests for insulation resistance in accordance with the requirements of the National Electrical Code and insure that all circuits are free from short circuits.

- D. Keep a calibrated voltmeter and ammeter available at all times and provides service for test readings when and as required, up until the project is accepted by the Owner.
- E. Electrical Testing and Verification: Refer to the following specification sections (as applicable) for required tests and verifications:
 - 1. 260519 – Low Voltage Electrical Power Conductors and Cables
 - 2. 260526 – Grounding and Bonding for Electrical Systems
 - 3. 262416 – Panelboards
 - 4. 262726 – Wiring Devices
 - 5. 283100 – Fire Alarm – Addressable

1.17 AS-BUILT DRAWINGS:

- A. Show on black or blue line prints in red ink all changes from original plans made during the installation. Return two (2) sets of red marked drawings, specifications and addenda, as set forth in the General Conditions, to the Architect upon completion of the project.

1.18 FINAL INSPECTION:

- A. Final inspection will be made upon written request from the General contractor after the project is completed; in accordance with the Supplementary General Conditions.
- B. Furnish a workman familiar with this project to accompany the Engineer on final inspection and have available ladders, drop cords, and other equipment as required to gain access to any portion of this system.
- C. This Contractor and his principal subcontractors shall be represented at the inspection by a person of authority responsible to demonstrate to the engineer that his work conforms to the intent of the plans and specifications.
- D. Extra inspections made necessary by the Electrical Contractor's failure to comply with the conditions as set forth above shall be charged to the Contractor for the Inspector's time both on the job and spent in travel between the office and the project site.

1.19 GUARANTEE:

- A. Guarantee all work, material and equipment for a period of one year after date of substantial completion.
- B. During the one year guarantee period the Electrical Contractor shall be responsible for any defects which develop in the electrical systems. Upon notification of a defect by the General Contractor the Electrical Contractor shall make immediate effort to correct it and shall notify the Architect when this work is completed.
- C. Repairs and/or replacements shall be made with no cost to Owner.
- D. Provide as part of the work of this contract, in addition to the first year's guarantee on equipment and materials, the following routine maintenance and inspection. (The one year time period will not start until each item is completed in accordance with plans and specifications and accepted by the Owner). Correct and adjust all emergency systems, controls, fire alarm, transformer, etc. This service to be provided throughout the guarantee period.

1.20 SINGULAR NUMBER:

- A. Where any device or part of equipment is referred to in these specifications in the singular number (such as "the switch"), such reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

1.21 LOW-VOLTAGE SYSTEMS:

- A. Equipment and wiring for special systems shall be as shown in the following schedule:

SYSTEM	EQUIPMENT FURNISHED BY	EQUIPMENT INSTALLED BY	WIRING FURNISHED AND INSTALLED BY
Clock	Contractor	Contractor	Contractor
Voice/Data	Contractor	Contractor	Contractor
CATV	Contractor	Contractor	Contractor
Fire Alarm	Contractor	Contractor	Contractor

- B. Power wiring for low-voltage systems shall be furnished and installed by the contractor as shown on the drawings and as required by the equipment manufacturer.
- C. Low voltage outlets shall be installed as shown on the drawings and shall be as specified for voice outlets, hereinbefore, or as otherwise shown or required by the application or by the equipment manufacturer.
- D. Fire alarm systems shall be completely installed in separate conduit systems. All cable for these systems shall be in conduit and shall not be combined with any other system cable. Conduits systems shall be furnished and installed by the Electrical Contractor.
- E. Conduit for low-voltage systems other than fire alarm shall be limited to the following and shall be furnished and installed by the Electrical Contractor.
1. Conduit in walls, from outlets to accessible ceilings, terminated with open end bushing above ceiling.
 2. Conduits between floors, terminated with open end bushings.
 3. Conduits across fire and/or smoke walls, terminated with open end bushings, and sealed with approved fire rated material.
 4. Other conduits as shown on drawings.
- F. Conduits shall be sized as required by the number and type of conductors applied and/or as noted on plans (minimum 1") and shall be not smaller than sizes recommended by the equipment manufacturer. All conduits shall be labeled to identify which system it is to be used: Fire Alarm, intercom, etc.
- G. When ceiling voids are used as air return plenums, only U.L. Listed plenum cable shall be used or cables shall be completely routed in conduit.
- H. All low voltage wiring installed in ceiling voids shall be bundled, neatly routed, suspended above the grid system or located in cable tray and labeled with appropriate tags as to service.

- I. Low voltage wire and cable shall be specifically designed to function with equipment supplied. Cable shall be color coded for ease of installation and service, twisted, shielded, and grounded for control of voice circuits and covered with wear-resistant moisture proof protective insulation. Wire shall bear manufacturer's trademark either embossed or printed on cable.
- J. Low-voltage systems shall be provided with a minimum of 20% spare capacity upon completion of the project unless otherwise noted.

END OF SECTION

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

- A. Section includes:
 - 1. Building wires and cables rated 600 VAC and less.
 - 2. Connectors, splices, and terminations rated 600 VAC and less.
 - 3. Wire lubricating compound.
 - 4. Control wiring.
 - 5. Communication and signal wiring.

1.3 SUBMITTALS

- A. Product Data (Where indicated in Section “Common Work Results for Electrical”, provide the following information): For each type of product indicated.

1.4 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 use.
- B. Comply with NFPA 70.
- C. Comply with NEMA WC 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES (POWER AND LIGHTING):

- A. Conductors and Cables: NEMA WC 70, except as hereinafter specified.
 - 1. All conductors shown on plans are sized for copper.
 - 2. UL label required.
- B. Single Conductor:
 - 1. Soft annealed copper.
 - 2. Stranded for sizes No. 8 and larger. Solid or stranded for sizes No. 10 and smaller, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise.
 - 3. Minimum size No. 12, except where larger sizes are shown. (Size No. 14 minimum for controls).
- C. Stranding:

1. Conductors between stationary and moving devices, such as hinged doors or panels, shall have Class H or Class K stranding. All other conductors shall have Class B or Class C stranding.

D. Insulation:

1. THHN-THWN, XHHW - Sizes No. 12 and larger.

2.2 SPLICES AND JOINTS:

A. In accordance with UL 486 A, B, D and NEC.

B. Split-bolt type connectors are not allowed.

C. Branch circuits (No. 10 and smaller):

1. Connectors: Solderless, screw-on, reusable pressure cable type, 600 volt, 105 degree C. with integral insulation, approved for copper and aluminum conductors.
2. The integral insulator shall have a skirt to completely cover the stripped wires.
3. The number, size, and combination of conductors, as listed on the manufacturer's packaging shall be strictly complied with.

D. Branch Circuits (No. 8 and No. 6):

1. Connectors: Pre-insulated, mechanical, reusable cable type, 600 volt, 90 degree C. with integral insulation, approved for copper and aluminum conductors, cold temperature rated to -45 degree C. Connectors shall be equal to those manufactured by Polaris Connectors.
2. Provide connectors rated for the location where installed.
3. The number, size, and combination of conductors, as listed on the manufacturer's packaging shall be strictly complied with.

E. Feeder Circuits:

1. All feeder conductors shall be the same size and type and be continuous from the overcurrent device to the panel or equipment the feeder terminates at.
2. Connectors shall be indent type, UL listed for use with the size and type of wire installed of high conductivity and corrosion-resistant material. Do not install more than one conductor per connector unless the connector is UL listed for use with the number of conductors installed.
3. Power distribution blocks shall be provided for splices or where quantity or size of conductors exceeds the terminal rating of the device to be connected. Power distribution blocks shall be equal to Square D by Schneider Electric Class 9080 Type LB or Mersen Electrical Power MPDB series. Provide with covers. Power distribution blocks shall be securely mounted in a code sized enclosure.
4. Field installed compression connectors for cable sizes 250 kcmil and larger shall have not less than two clamping elements or compression indents per wire.
5. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Insulation rating shall be not less than that of the conductor that is being joined.
6. Plastic electrical insulating tape: Flame retardant, cold and weather resistant.

2.3 CONTROL WIRING:

- A. Unless otherwise specified in other sections of these specifications, size control wiring as specified for power and lighting wiring, except the minimum size shall be not less than No. 14, 90 degrees C. insulation. Where stranded conductors are used, provide with spade type insulated copper terminals.
- B. Size wire large enough so that the voltage drop under inrush conditions does not adversely affect operation of the controls.

2.4 COMMUNICATION AND SIGNAL WIRING:

- A. Shall conform to the recommendations of the manufacturers of the communication and signal systems; however, not less than what is shown.
- B. Wiring shown is for typical systems. Provide wiring as recommended by the manufacturer for the systems being furnished.
- C. Multi-conductor cables shall have the conductors color coded.

2.5 WIRE LUBRICATING COMPOUND:

- A. The cable pulling lubricant shall be compatible with all cable jackets. The lubricant shall be UL (or CSA) listed. The lubricant shall contain no waxes, greases, silicones, or polyalkylene glycol oils or waxes.
- B. A 200-gram sample of the lubricant, when placed in an one-foot, split metal conduit and fully dried for 24 hours at 105 degrees C, shall not spread a flame more than three-inches beyond a point of ignition at a continued heat flux of 40 kW/m². Total time of test shall be one-half hour.
- C. Approved Lubricant is:
 - 1. Polywater J from American Polywater Corporation

PART 3 - EXECUTION

3.1 INSTALLATION, GENERALLY:

- A. Install in accordance with the NEC, and as specified.
- B. Install all wiring in raceway systems.
- C. Where No. 10 or No. 12 stranded conductors terminate at receptacles, toggle switches, or other devices with a screw-type connection, provide a solid conductor pigtail or spade-type connector listed for use with the appropriate class of stranded wire.
- D. Install a ground wire sized per NEC 250.122 in each conduit containing phase conductors.
- E. Color Code:
 - 1. All conductors shall be identified by circuit number and color coding at all termination points and splices. All conductors shall be identified in all pull and

junction boxes by the following method of color coding. Means of identification shall be permanently posted at each branch circuit panel with a nameplate identifying color coding system used in that panelboard.

Phase	208/120V			
A	Black			
B	Red			
C	Blue			
Neutral	White			
Ground	Green			

2. Use solid color compound or solid color coating for No. 6 and smaller branch circuit conductors and neutral sizes.
 3. Phase conductors No. 4 and larger color code using one of the following:
 - a. Solid color compound or solid color coating.
 - b. Colored as specified using 3/4-inch wide tape. Apply tape in half overlapping turns for a minimum of three-inches for terminal points, and in junction boxes, pull boxes, troughs, manholes, and handholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable stating size and insulation type.
 4. Where neutrals are located in the same raceway, junction box or enclosure, neutrals shall be marked or labeled to indicate which circuit conductor (phase conductor) they are associated with. Neutrals (with stripes matching the associated phase conductor color) meeting the requirements of NEC Section 200.6 are acceptable for this purpose.
 5. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
 6. Provide plastic engraved color code legend on each panelboard and switchboard per NEC Section 210.5 (C).
 7. All improperly color coded conductors will be completely replaced at no additional cost to Owner.
- F. All cable and wiring shall be continuous between electrical equipment. Splices shall not be added except as required for taps in branch circuits or as approved by the engineer.
- G. Splice cables and wires only in outlet boxes, junction boxes, pull boxes, manholes, or handholes. Do not splice cables in panelboards, switchboards, disconnects, etc.
- H. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.
- I. For panelboards, cabinets, wireways, switches, and equipment assemblies, neatly form, and tie all cables.
- J. Seal cable and wire entering a building from underground between the wire and conduit, where the cable exits the conduit, with a non-hardening approved compound.
- K. Wire Pulling:

1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
 2. Use ropes made of nonmetallic material for pulling feeders.
 3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the Engineer.
 4. Pull multiple cables into a single conduit with a single continuous pull.
 5. Use wire lubricant per this specification when recommended by the cable manufacturer or as required to prevent damage to cables during installation.
- L. Individual neutrals shall be provided for each circuit. Multi-wire branch circuits (i.e. Two or more phase sharing a neutral conductor) shall not be allowed, unless specifically noted or shown on the plans. Where multi-wire branch circuits are shown or noted on the plans, provide a disconnecting means that will simultaneously disconnect all phase conductors at the panel where the branch circuit originates.

3.2 SPLICE INSTALLATION:

- A. Splices and terminations shall be mechanically and electrically secure.
- B. Where the Engineer determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices at no additional cost to the Owner.

3.3 CONTROL, COMMUNICATION, AND SIGNAL WIRING INSTALLATION:

- A. Unless otherwise specified in other sections of these specifications, install wiring as described below. Wiring shall be connected to perform the functions shown and specified in other sections of this specification.
- B. Except where otherwise required, install a separate power supply circuit for each system, or control equipment, or control power. Circuit to nearest 120 volt panel or nearest emergency panel if equipment controlled is connected to emergency system. Use spare 20 Amp breakers in panels where none are designated. Verify all requirements with actual equipment supplied in field.
- C. Install a breaker lock-on clip on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems. Lock-on clips for circuit breakers serving fire alarm systems shall be painted red.
- D. System voltages shall not exceed 120 volts and shall be lower voltages where shown on the drawings or required by the NEC.
- E. Wire and cable identification:
 1. Install a permanent wire marker on each wire at each termination, outlet box, junction box, panel, and device. Markers shall be typed or handwritten and shall be clearly legible.
 2. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
 3. Wire markers shall retain their markings after cleaning.
 4. In each manhole and handhole, install permanent, waterproof tags to identify the cable type/system and the building or area served.

3.4 FEEDER IDENTIFICATION:

- A. In each, interior pullbox and junction box, identify each phase, neutral and/or ground conductor by conductor color coding or tape based on system voltage.
- B. In manholes and handholes, install permanent, waterproof tags to identify the cable type. Identify each phase, neutral, and/or ground conductor by conductor color coding or tape based on system voltage.

3.5 FIELD TESTING:

- A. Feeders and branch circuits shall have their insulation tested after installation and before connection to utilization devices such as fixtures, motors, or appliances.
- B. Test shall be performed by megger and conductors shall test free from short-circuits and grounds.
- C. Test conductors' phase-to-phase and phase-to-ground.
- D. Megger motors after installation but before start-up and test free from grounds.
- E. The Contractor shall furnish the instruments, materials, and labor for these tests.

END OF SECTION

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

- A. This section includes grounding and bonding systems and equipment.

1.3 SUBMITTALS:

- A. Product Data (Where indicated in Section "Common Work Results for Electrical", provide the following information): For each type of product indicated.
- B. As-Built Data: Plans showing dimensioned as-built locations of grounding features, including the following:
 - 1. Ground rods.
 - 2. Grounding arrangements and connections for separately derived systems.
- C. Test Records: Submit the following test records to the Engineer for review and approval, and include in the operational and maintenance manuals:
 - 1. Grounding system tests per paragraph FIELD QUALITY CONTROL in Part 3 of this Section.

1.4 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

2.1 CONDUCTORS:

- A. Insulated General Purpose: UL and NFPA 70 approved types, copper, with THW, XHHW or dual rated THHN-THWN insulation color identified green.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B3.
 - 2. Stranded Conductors: ASTM B8.
- C. Size conductors not less than what is shown on the drawings and not less than required by the NFPA 70.

2.2 GROUND BUS:

- A. Pre-drilled 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 shall comply with UL 891 for use in switchboards, 600V and shall be Lexan or PVC, impulse tested at 5000V.

2.3 GROUND RODS:

- A. Copper-clad steel, sectional type, 3/4-inch diameter by 20 feet long.

2.4 CONNECTORS:

- A. Listed and labeled by a NRTL acceptable to the 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.
- C. Welded Connections:
 - 1. Exothermic welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
 - 2. For structural steel, steel grounding stud for compression connector.
- D. Compression Connectors: Hydraulic crimped, irreversible compression type kits. Connectors shall be factory filled with oxide inhibitor. All crimps shall be made with a hydraulic tool that embosses the index number on the outside of the connector.
- E. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long barrel, two-bolt connection to ground bus bar.
- F. All splices and grounding electrode connections shall be made with exothermic welds or with hydraulic compression fittings.

2.5 INTERSYSTEM GROUND BAR:

- A. Complies with UL 467.
- B. Base and cover shall be impact resistant and UV rated.
- C. Shall be rated for copper and aluminum conductors.
- D. Shall have provisions for one main grounding electrode conductor and a minimum of four bonding conductors.

PART 3 - EXECUTION

3.1 APPLICATIONS:

- A. Conductors: Install solid or stranded conductors for #10 AWG and smaller and stranded conductors for #8 AWG and larger unless otherwise indicated.

- B. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
- C. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors or hydraulic compression connectors except as otherwise indicated.
 - 3. Connections to Structural Steel: Welded connectors.
 - 4. Aboveground Connections to Ground Rods: Bolted connectors.

3.2 INSTALLATION, GENERALLY:

- A. Ground in accordance with the NFPA 70 as shown, and as hereinafter specified. All equipment ground conductors shall be terminated on a ground bus or ground lug attached to equipment can. It is assumed that existing building grounding systems meet the below requirements. Contractor to verify existing service grounding and notify engineer of record of any concerns.
- B. System Grounding:
 - 1. Secondary service neutrals shall be grounded at the supply side of the secondary disconnecting means and at the related transformers.
 - 2. Separately derived systems (transformers downstream from the service entrance) ground the secondary neutral.
 - 3. Individual Buildings: Bond Main Disconnect ground bus to building steel, 20 foot re-bar in foundation, water pipe, driven ground, and ground ring.
- C. Equipment Grounding:
 - 1. Metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be grounded for personnel safety and to provide a low impedance path for possible ground fault currents.

3.3 SECONDARY EQUIPMENT AND CIRCUITS:

- A. Main Bonding Jumper: Connect the secondary service neutral to the ground bus in the service equipment.
- B. Water Pipe and Supplemental Electrode:
 - 1. Provide a ground conductor connection between the service equipment ground bus and the metallic water pipe system. Jumper insulating joints in the water pipe.
 - 2. Provide a supplemental grounding electrode and bond to the water pipe ground, or connect to the service equipment ground bar.
- C. Service Disconnect: Provide a ground bar bolted to the enclosure with lugs for connecting the various grounding conductors. Connect the neutral to the ground bus (main bonding jumper).

- D. Switchboards:
1. Connect the various feeder green grounding conductors to the ground bus in the enclosure with suitable pressure connectors.
 2. Connect the grounding electrode conductor to the ground bus.
 3. Connect metallic conduits, which terminate without mechanical connection to the housing, by grounding bushings and ground wire to the ground bus.
- E. Conduit Systems:
1. Ground all metallic conduit systems.
 2. Non-metallic conduit systems shall contain a grounding conductor.
 3. Conduit provided for mechanical protection containing only a grounding conductor, bond to that conductor at the entrance and exit from the conduit via grounding bushings.
- F. Feeders and Branch Circuits: Install green grounding conductors with feeders and branch circuits in all feeders and branch circuits and in any raceway containing a phase conductor.
- G. Boxes, Cabinets, Enclosures, and Panelboards:
1. Bond the grounding wires to each pullbox, junction box, outlet box, cabinets, and other enclosures through which the ground wires pass (except for special grounding systems for intensive care units and other critical units shown.).
 2. Make ground wire connections to ground bus in motor control centers, panelboards, etc.
- H. Receptacles and toggle switches are not approved for grounding through their mounting screws. Ground with a ground wire from green ground terminal on the device to the outlet box ground screw.
- I. Ground lighting fixtures to the green grounding conductor of the wiring system when the green ground is provided; otherwise, ground the fixtures through the conduit systems. Fixture connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.
- J. Fixed electrical appliances and equipment shall have a ground lug installed for termination of the green ground conductor.
- K. Telephone Terminal Boards: Provide a #3/0 AWG CU ground in 1" C. from each board to the main service disconnect ground bus.

3.4 CONDUCTIVE PIPING:

- A. Bond all conductive piping systems in the building to the electrical system ground. Bonding connections shall be made as close as practical to the water pipe ground or service equipment ground bus.

3.5 SPLICES:

- A. All splices and grounding electrode connections shall be made with exothermic welds or with hydraulic compression fittings.

3.6 GROUNDING RESISTANCE:

- A. Grounding system ground resistance must not exceed 5 ohms. Final tests shall assure that this requirement is met.
- B. Where permanent ground connections are required, make the connections by the exothermic process or hydraulic compression method to form solid metal joints.
- C. Where rock prevents the driving of vertical ground rods, install grounding electrodes in horizontal trenches to achieve the specified resistance.
- D. Where more than one ground rod is required to meet the specified resistance, they shall be located at least 10 feet apart. Interconnect with grounding electrode conductor below grade and as otherwise indicated.

3.7 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 subject to strain, impact, or damage.
- B. Grounding electrode conductors shall be continuous.

3.8 FIELD QUALITY CONTROL:

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation. Inspect compression type connections for proper die index number embossment.
- B. Perform the following testing:
 - 1. After installing grounding system, but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Test completed grounding system as each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after the last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81. Submit test results to the Engineer.
 - c. Excessive Ground Resistance: If resistance to ground exceeds specified values, promptly notify Engineer and include recommendations for reducing ground resistance.

END OF SECTION

SECTION 26 05 33 – RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Description:
 - 1. This section includes the furnishing, installation, and connection of raceways, fittings, and boxes to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.
 - 2. The term conduit, as used in this specification, shall mean any or all of the raceway types specified.
- B. Section Includes:
 - 1. Metal conduits, tubing, and fittings.
 - 2. Non-metallic conduits and fittings.
 - 3. Metal wireways and auxiliary gutters.
 - 4. Surface raceways.
 - 5. Boxes and enclosures.
 - 6. Handholes and boxes for exterior underground cabling.

1.3 DEFINITIONS:

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.
- D. RGS: Rigid galvanized steel.

1.4 ACTION SUBMITTALS:

- A. Product Data (Where indicated in Section “Common Work Results for Electrical”, provide the following information): For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings (Where indicated in Section “Common Work Results for Electrical”, provide the following information): For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS:

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

PART 2 - PRODUCTS

2.1 CONDUIT:

- A. Raceway Size: In accordance with the NFPA 70 but not less than 1/2-inch unless otherwise shown. Where permitted by the NFPA 70, 1/2-inch flexible conduit may be used for connections to recessed lighting fixtures.
- B. Raceway Supports:
 - 1. Parts and hardware: Zinc-coat or provide equivalent corrosion protection.
 - 2. Pipe Straps: Fed. Spec. FF-S-760, Type I, Style A or B.
 - 3. Individual Raceway Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
 - 4. Multiple Raceway (trapeze) hangers: Not less than 1-1/2 by 1-1/2 inch, 12 gauge steel, cold formed, lipped channels or not less than 2-1/8 by 2-1/8 inch, 18 gauge B-Line "4Dimension Channel"; with not less than 3/8-inch diameter steel hanger rods.
 - 5. Solid Masonry and Concrete Anchors: Fed. Spec. FF-S-325; Group III self-drilling expansion shields, or machine bolt expansion anchors Group II, Type 2 or 4, or Group VIII.
- C. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.

2.2 RACEWAYS:

- A. Install raceway types as shown on drawings and as listed below.
- B. Metal Conduit:
 - 1. Rigid steel: UL 6 and ANSI C80.1.
 - 2. Rigid aluminum: UL 6A and ANSI C80.5.
 - 3. Rigid intermediate steel conduit (IMC): UL 1242 and ANSI C80.6.
 - 4. Electrical metallic tubing (EMT): U.L. 797 and ANSI C80.3. Maximum size 5-inch. Permitted only with cable rated 600 volts or less.
 - 5. Flexible steel conduit (commercial Greenfield): UL 1, zinc-coated steel.
 - 6. Liquid-tight flexible metal conduit: UL 360 flexible galvanized steel tubing covered with extruded liquid-tight jacket of polyvinyl chloride (PVC). Provide conduit with a continuous copper bonding conductor spiral between the convolutions.

7. PVC Coated Rigid Steel: NEMA RN 1. Conduit and fittings shall be as manufactured by Robroy Industries; Plasti-Bond, Perma-Cote, and KorKap or Thomas & Betts; Ocal. Any deviation will require approval of the specifying Engineer or Owner.
 - a. Shall be UL listed.
 - b. All male threads on conduit, elbows and nipples shall be protected by application of a urethane coating.
 - c. All female threads on fittings or conduit couplings shall be protected by application of a urethane coating.

C. Conduit Fittings for Metal Conduit:

1. Comply with NEMA FB 1 and UL 514B.
2. Rigid steel and IMC conduit fittings:
 - a. Standard threaded couplings, locknuts, bushings, and elbows: Fed. Spec. W-F-408, except only material of steel or malleable iron is acceptable. Integral retractable type IMC couplings are acceptable also.
 - b. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure
 - c. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted. Bushings for conduit smaller than 1-1/4-inch shall have flared bottom with ribbed sides.
 - d. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
 - e. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank coverplates having the same finishes as that of other electrical plates in the room.
 - f. In trade sizes 2-1/2 inches to 4-inches for rigid steel raceway or intermediate metal raceway, contractor may use Allied 'Kwik-Couple' fittings in lieu of individual steel couplings. 'Kwik-Couple' fittings shall not be used in hazardous locations. Where 'Kwik-Couple' fittings are used exterior for vertical risers, install fitting with taper end up.
3. Rigid aluminum conduit fittings:
 - a. Standard threaded couplings, locknuts, bushings, and elbows: Malleable iron, steel or aluminum alloy materials. Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
 - b. Locknuts and bushings: As specified for rigid steel and IMC raceways.
 - c. Set screw fittings: Not permitted for use with aluminum raceway.
4. Electrical metallic tubing fittings:

- a. Fed. Spec. W-F-408, except only material of steel for compression type. Steel or die-cast is acceptable for set screw type. Die-cast compression is not acceptable.
 - b. Couplings and connectors: Concrete tight and rain tight, with connectors having flared throats. Use gland and ring compression type or set screw type couplings and connectors. Set screw type couplings for conduit 2 inches and larger shall be four set screws each. Use set screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
 - c. Indenter type connectors or couplings are prohibited.
 - d. In trade sizes 1-1/4 inches to 4 inches, contractor may use Allied “Kwik-Fit EMT” or “Kwik-Fit Compression EMT” fittings in lieu of individual steel couplings.
5. Flexible steel conduit (greenfield) fittings:
- a. Fed. Spec. W-F-406 and UL 5, except only steel or malleable iron material is acceptable.
 - b. Clamp type, with insulated throat.
6. Liquid-tight flexible metal conduit fittings:
- a. Fed. Spec. W-F-406, except only steel or malleable iron material is acceptable.
 - b. Type incorporating a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
7. Expansion and deflection couplings:
- a. UL 467 and UL 514.
 - b. Accommodate, 1.9 cm (0.75”) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
 - c. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, NFPA 70 Section 250.98, and the NFPA 70 code tables for ground conductors.
 - d. Shall be watertight, seismically qualified, corrosion-resistant, threaded for and compatible with rigid or intermediate metal conduit.
 - e. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.
 - f. Expansion fittings shall accommodate a minimum of 4-inches of movement.
- D. Nonmetallic Conduit:
- 1. PVC Conduit: NEMA TC 2 and UL 651 Schedule 40, conduit size is 3/4-inch minimum.
- E. Conduit Fittings for Non-Metallic Conduits:
- 1. PVC Conduit: Comply with NEMA TC 3; match to conduit type and material.

2.3 OUTLET BOXES:

- A. UL-50, UL514A and NEMA OS 1.
- B. Cast metal where required by NFPA 70 or shown, and equipped with rustproof boxes; NEMA FB 1.
- C. Sheet metal boxes: 4-inch square, galvanized steel, except where otherwise shown.
- D. Boxes installed in concrete or masonry and boxes larger than two gang shall be masonry type.
- E. Box extensions used to accommodate building finishes shall be of the same material as the recessed box.
- F. Boxes for use with IMC or RGS raceways shall be cast 'F' type or stainless steel unless noted otherwise on the drawings.
- G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

2.4 WIREWAYS AND AUXILIARY GUTTERS:

- A. Sized according to NFPA 70.
- B. Equip with hinged covers, except where removable covers are shown. Wireways shall only be permitted as indicated on the drawings or approved by the Engineer.
- 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 a complete system.
- D. Metal Wireways:
 - 1. Sheet metal complying with UL 870 and NEMA 250.
 - 2. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70 and shall be marked for intended location and application.

2.5 PULL AND JUNCTION BOXES:

- A. Small boxes shall comply with NEMA OS 1.
- B. Larger boxes shall comply with UL 50 and NEMA 250.
- C. Pull and junction boxes shall be code gauge steel boxes with hinged, bolted or screwed covers. Boxes shall be flush or surface mounted as shown or required.
- D. Junction and pull box shall be installed where shown on drawings and additional boxes shall be installed if required for pulling of wire provided location and installation is approved by the Architect. All boxes shall be code construction with screw type cover and shall be installed in accessible locations.

- E. Pull and junction boxes for use with IMC or RGS raceways shall be cast 'FS' type or stainless steel unless noted otherwise on the drawings. Comply with NEMA FB 1 and UL 1773 with gasketed cover.

2.6 FLOOR BOXES:

- A. Floor boxes shall be as specified on the drawings or in the Special Outlet Schedule. General installation / construction shall be as follows:
 - 1. Shall be listed and labeled as defined in NFPA 70.
 - 2. Floor box housings for single and multi-gang floor boxes shall be fully adjustable, concrete tight with knockouts on bottom and all four sides (1/2", 3/4", 1" sizes and as otherwise scheduled). Deep boxes shall be used when concrete floor thickness above any part of deck is 4-inch thick or more. Shallow boxes shall be used when concrete floor thickness is 3-inch up to 4-inch.
 - 3. Cover plates shall be polished brass unless noted otherwise. Dual hinged lift lids for duplex receptacles, removable plug insert sized to match the receptacle to be installed for single special receptacles, telephone, TV, microphone, or other low voltage devices.
 - 4. Provide low profile carpet flanges in all carpeted areas. Colors to be per Architect.
 - 5. Approved manufacturers shall be Legrand/Wiremold, Hubbell or Steel City unless noted otherwise on the plans and/or in the special outlet schedule.

2.7 CONCEALED SERVICE FLOOR BOX:

- A. Large capacity (4 gang minimum) multi-service type: Provide with two or more duplex receptacles and other devices as indicated. Verify color with Architect. Steel City #665 Series or Hubbell # HBLCF8 Series.

2.8 SURFACE METALLIC RACEWAY:

- A. Raceways shall be Wiremold #500 minimum or #700 for small sizes and Wiremold Series 2000, 3000, and 4000 for larger capacities or equal by Mono Systems, Inc. In all cases, do not exceed the fill per the manufacturers published data.
- B. Use outlets and fittings by the same manufacturer and approved for use with the raceway.
- C. Provide multiple compartment raceways where power and low voltage wiring are located in the same raceway.

2.9 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
- B. Comply with SCTE 77.
- C. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
- D. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
- E. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

- F. Cover Legend: Molded lettering shall be “ELECTRIC” for power handholes and “COMMUNICATIONS” or “CONTROLS” as applicable for low voltage handholes.
- G. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
- H. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
- I. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete.

PART 3 - EXECUTION

3.1 RACEWAY:

- A. Minimum 1/2-inch above grade, 3/4-inch below grade, and 1-inch on site, unless otherwise noted.
- B. A ground wire, sized per NFPA 70 Section 250.122 shall be installed in all conduits containing phase conductor(s).
- C. RGS or IMC must be used at all times when exposed to weather or physical abuse and in all NFPA 70 classified hazardous locations. EMT may not be used in direct contact with earth, or in concrete slabs on grade.
- D. U.L. approved Schedule 40 P.V.C. conduit may be used where feeders or branch circuits are to be run in earth or slabs (3/4" minimum).
 - 1. Use PVC coated RGS ells and risers approved for underground use. All conduit risers through concrete floors shall be RGS from below the top of the floor slab. Use conduit adapters when converting from PVC to steel conduit.
 - 2. Use plastic spacers when more than one conduit is installed together. See Drawings for areas requiring concrete encasement.
- E. All nonmetallic (PVC and fiberglass) conduits shall be provided with separate ground conductor sized per NFPA 70.

3.2 PENETRATIONS:

- A. Cutting or Holes:
 - 1. Locate holes in advance where they are proposed in the structural sections such as ribs or beams. Obtain the approval of the Structural Engineer prior to drilling through structural sections.
 - 2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed, except where permitted by the Structural Engineer as required by limited working space.
- B. Fire Stop:

1. Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases, and maintains specified fire rating. Completely fill and seal clearances between raceways and openings with the fire stop material. See Section "Common Work Results for Low Voltage Systems Cabling" for firestopping requirements for low voltage cabling sleeves.

C. Fire Barrier Penetration Seals:

1. Manufacturer: Subject to compliance with requirements, provide fire barrier penetration seals of one of the following:
 - a. Electro Products Div./3M
 - b. Nelson; Unit of General Signal.
2. Provide seals for any opening through fire-rated walls, floors, ceilings, or assemblies used as passage for components such as conduits or cables.
3. Cracks, voids or holes up to 4-inch diameter: Use putty or caulking, one-piece intumescent elastomer, non-corrosive to metal, compatible with synthetic cable jackets, and capable of expanding 10 times when exposed to flame or heat and UL-listed.
4. Openings greater than 4-inch diameter and raceway sleeves thru floors at telephone terminal boards: Use sealing system capable of passing 3-hour fire test in accordance with ASTM E-814, consisting of wall wrap or liner, partitions, and end caps capable of expanding when exposed to temperatures of 250 degrees to 350 degrees F (121 to 177·C), that is UL-listed. KBS "Sealbags" manufactured by P-W Industries will be acceptable.
5. Execution: Fill entire opening with sealing compound. Adhere to manufacturer's installation instructions. All fire barrier seals shall meet the rating of the wall.

D. Waterproofing:

1. Install sleeves and sleeve seals at exterior floor, exterior wall, and roof conduit penetrations and completely seal clearances around the conduit and sleeve and make watertight as specified in Section, SEALING AND CAULKING.

3.3 CONDUIT SYSTEMS INSTALLATION, GENERAL:

- A. Installation: In accordance with UL, NFPA 70, as shown, and as hereinafter specified.
 1. Where non-metallic (PVC or fiberglass) conduits are used, a ground wire sized per NFPA 70 Section 250.122 shall be provided if not already specified.
- B. All branches of the emergency system shall be installed entirely independent of other raceway systems. Common supports and hangers may be used.
- C. Raceway Burial Depths: (Underground work)
 1. 18" minimum, 30" maximum cover to grade or bottom of floor slab.
 2. 24" minimum under streets, highways, roads, alleys, driveways and parking lots.
 3. 4" minimum below concrete slab inside a building.

4. Prior to any underground work, contractor shall verify and locate all existing underground utilities. All existing utilities may not be shown on the drawings. Verify in field with owner and with utility locating services. The contractor shall exercise extreme caution when trenching or boring, hand digging at all crossings and where in close proximity of existing utilities. Repair existing parking lots, streets, roads, alleys, driveways, etc. to its original condition in a timely manner prior to substantial completion. Contractor shall be responsible for any damage to underground utilities.
5. Underground conduits shall be installed in a sand bed and in an organized manner.

D. Install raceways as follows:

1. Comply with NECA 1, comply with NECA 101 for metal conduit and NECA 102 for aluminum conduit except where requirements on drawings or this article are stricter.
2. In complete runs before pulling in cables or wires.
3. Flattened, dented, or deformed raceways are not permitted. Remove and replace the damaged raceways with new undamaged material.
4. Assure raceway installation does not encroach into the ceiling height head room, walkways, or doorways.
5. Cut square with a hacksaw, ream, remove burrs, and draw up tight.
6. Mechanically and electrically continuous.
7. Independently support raceway. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, mechanical piping, or mechanical ducts.). Group raceways with common supports where possible. Conduit shall be supported within 12-inches of connectors.
8. Close ends of empty raceway with plugs or caps at the rough-in stage to prevent entry of debris, until wires are pulled in.
9. Raceway installations under fume and vent hoods are prohibited.
10. Secure raceways to cabinets, junction boxes, pull boxes and outlet boxes with bonding type locknuts. For RGS and IMC raceway installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make raceway connections to junction box covers.
11. Flashing of penetrations of the roof membrane is specified in Section, FLASHING AND SHEET METAL.
12. Raceways shall not be used as a support.
13. Use thread compounds that are UL approved conductive type to insure low resistance ground continuity through the raceways.
14. Tightening set screws with pliers is prohibited.
15. Keep raceways a minimum of 6 inches away from parallel runs of flues and steam or hot-water pipes.

E. Raceway Bends:

1. Make bends with standard raceway bending machines.
2. Raceway hickey may be used for slight offsets, and for straightening stubbed out raceways.
3. Bending of raceways with a pipe tee or vise is prohibited.

F. Raceways Installed Under Metal - Corrugated Sheet Roof Decking

1. Where rigid metal conduit or intermediate metal conduit is not used, raceways shall be installed and supported so the nearest outside surface of the raceway is not less than 1.5 inches from the nearest surface of the roof decking.

G. PVC coated RGS:

1. Use only fittings listed for use with this type of conduit.
2. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduit and fittings. Use sealant recommended by conduit manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. Right angle beam clamps and U bolts shall be specially formed and sized to snugly fit the outside diameter of the coated conduit.
4. All clamping, cutting, threading, bending, and assembly instructions listed in the manufacturer's installation guide should be vigorously followed. Installer certification, before installation, is required.

3.4 CONCEALED WORK INSTALLATION:

A. General:

1. Raceway and Outlet Boxes Installation: All raceway systems work and outlet boxes shall be installed concealed in walls, floor and roof construction or concealed within furred spaces or above ceilings. In equipment or mechanical rooms exposed work shall include feeders and connections to equipment unless noted otherwise.

B. In Concrete:

1. Raceway: RGS, IMC, PVC or EMT; except do not install EMT in concrete slabs that are in contact with soil, gravel or vapor barriers.
2. Align and run raceways in direct lines.
3. Install raceways through concrete beams only when the following occurs:
 - a. Where shown on the structural drawings.
 - b. As approved by the Structural Engineer prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
4. Installation of raceways in concrete that is less than three inches thick is prohibited. All raceways installed in concrete shall be approved by the Structural Engineer.
 - a. Raceway outside diameter larger than one-third of the slab thickness is prohibited.
 - b. Space between raceways in slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.
 - c. Install raceways approximately in the center of the slab so that there will be a minimum of 3/4-inch of concrete around the raceways.
5. Make couplings and connections watertight.

C. Above Furred or Suspended Ceilings and in Walls:

1. Raceways for conductors 600 volts and below:

- a. RGS, IMC, rigid aluminum, or EMT. Types mixed indiscriminately in the same system are prohibited.
 - b. Do not use aluminum in wet locations or in contact with concrete.
2. Align and run raceways parallel or perpendicular to the building lines.
 3. Connect recessed or lay-in lighting fixtures and all other devices installed in a lay-in ceiling to raceway runs with flexible metal conduit extending from a junction box to the fixture. Provide a ground wire in all flexible conduits.
 4. Tightening set screws with pliers is prohibited.

3.5 EXPOSED WORK INSTALLATION:

- A. Raceways for Conductors 600 volts and below:
 1. RGS, IMC, rigid aluminum, or EMT. Types mixed indiscriminately in the system are prohibited.
 2. Do not use aluminum in wet locations or in contact with concrete.
 3. All raceways exposed to physical abuse and in all industrial pump, treatment plant locations shall be RGS, or IMC.
- B. Align and run raceways parallel or perpendicular to the building lines.
- C. Install horizontal runs close to the ceiling or beams and secure with raceway straps.
- D. Surface metallic raceways:
 1. Surface metallic raceway shall only be used where shown on the drawings, and in remodels and modifications to existing where wall and ceiling voids do not permit concealed installation but shall not be used at any other location unless called for on the drawings.
 2. All surface raceway and outlets must be painted to match the surface it is attached to.
 3. Install a ground wire sized per NFPA 70 Section 250.122 for the largest circuit in the raceway if not already specified.
- E. Painting:
 1. Paint exposed raceways as specified in Section, PAINTING.
 2. Paint raceways containing cables rated over 600 volts safety orange as specified in Section, PAINTING. In addition, paint legends, using 2-inch high black numerals and letters, showing the cable voltage rating. Provide legends where raceways pass through walls and floors and at maximum 20-foot intervals in between.

3.6 WET OR DAMP LOCATIONS:

- A. Unless otherwise shown, use raceways of RGS or IMC above grade. Use PVC conduit below grade, except RGS ells and risers shall be used.
- B. Provide sealing fittings, to prevent passage of water vapor, where raceways pass from warm to cold locations, i.e., (refrigerated spaces, constant temperature rooms, air conditioned spaces) or similar spaces.

- C. When RGS ells and risers are used below grade or when RGS or IMC conduit or RGS ells and risers are used below concrete building slabs in contact with soil, gravel, or vapor barriers, conduit shall have a minimum 20 mil PVC tape or coated with bituminous asphaltum compound.

3.7 CORROSIVE LOCATIONS:

- A. Conduit shall be PVC coated RGS.

3.8 MOTORS AND VIBRATING EQUIPMENT:

- A. Use flexible metal conduit (Type FMC) for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission. Provide liquid-tight flexible metal conduit Type (LFMC) for installation in exterior locations, kitchens, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, treatment plants, pump stations, and locations subject to seepage or dripping of oil, grease or water. Provide a green ground wire with all flexible metal conduit.

3.9 EXPANSION JOINTS:

- A. Expansion fittings shall be used wherever the change in length of PVC conduit due to temperature variation exceeds 0.25-inches per NEC Section 352.44.
- B. All conduits routed outdoors or in non-conditioned spaces (i.e., attics, non-insulated plenums, etc.) shall have expansion fittings per the following:
 - 1. Steel: One expansion fitting in runs longer than 40 feet. Provide additional expansion fittings every 200 feet.
 - 2. Aluminum: One expansion fitting in runs longer than 20 feet. Provide additional expansion fittings every 100 feet.
 - 3. PVC: One expansion fitting in runs longer than 20 feet. Provide additional expansion fittings every 50 feet.
- C. Equip raceways 3-inches and larger, that are rigidly secured to the building structure on opposite sides of a building expansion joint, with expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
- D. Equip raceways smaller than 3-inches, that are rigidly secured to the building structure on opposite sides of a building expansion joint, with junction boxes located 12-inches either side of the expansion joint. Connect junction boxes with 24-inches of flexible conduit that is slack (to allow for movement). Flexible conduit shall have an insulated copper bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 3-inches and larger conduits are acceptable.

3.10 RACEWAY SUPPORTS, INSTALLATION:

- A. All raceways shall have supports at maximum spacing of 10-feet and within 3-feet of a fitting, elbow, change of direction, box outlet or enclosure. Safe working load shall not exceed 1/4 of proof test load of fastening devices. This shall apply to both vertical and horizontal conduit runs.
- B. Use pipe straps or individual raceway hangers for supporting individual conduits.

- C. Support multiple raceway runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the raceways, wires, hanger itself, and 200 pounds. Attach each raceway with U-bolts or other approved fasteners.
- D. Support raceways independently of junction boxes; pull boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
- E. Fasteners and Supports in Solid Masonry and Concrete:
 - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
 - 2. Existing Construction:
 - a. Steel expansion anchors not less than 1/4-inch bolt size and not less than 1-1/8 inch embedment.
 - b. Power set fasteners not less than 1/4-inch diameter with depth of penetration not less than 3-inches.
 - c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
- F. Hollow Masonry: Toggle bolts are permitted. Bolts supported only by plaster are not acceptable.
- G. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- H. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
- I. Chair, wire, or perforated strap shall not be used to support or fasten conduit.
- J. Spring steel type supports "caddy clips" that are listed for the intended use are acceptable in appropriate locations.
- K. Vertical Supports: Vertical raceway runs shall have riser clamps and supports in accordance with NFPA 70 and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.11 BOX INSTALLATION:

- A. Boxes for Concealed Raceways:
 - 1. Mount flush. Boxes protruding from the finished wall surface or with more than 1/8-inch gap between the wall or outlet mounted in the box will be changed out with all wall reconstruction expense paid by the Electrical Contractor.
 - 2. Provide raised covers for boxes to suit the wall or ceiling, construction and finish.
- B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.
- C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.

- D. Outlet boxes in the same wall mounted back-to-back are prohibited.
- E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 4-inches square by 2-1/8 inches deep, with device covers for the wall material and thickness involved.
- F. Where lighting fixtures and appliance outlets are to be mounted in concrete or in plaster finish on concrete, outlet boxes shall be installed in forms at exact dimensions from bench marks, columns, walls or floors.
- G. Where lighting fixtures and appliances outlets are to be mounted on masonry walls and/or plastered furring or other finish, outlet boxes shall be roughed in to general location before installation of wall and furring and shall be reset to exact dimensions before walls and furring are constructed.
- H. All outlet boxes shall be set true to horizontal and vertical lines parallel to walls, floors and ceilings and true to finish lines. All boxes shall be secured to ceilings or walls so all installations are solidly mounted.
- I. Boxes mounted to wall studs shall be secured to a horizontal box mounting bracket equal to B-Line Series #BB2 or Caddy Series #SGB. B-Line Series #BB4, Caddy Series #H23 or equal one piece support brackets may be used for mounting light switch boxes only. However, metal stud clips with far side box supports are not acceptable.
- J. Boxes for exterior exposed work (where approved by the engineer) shall be Appleton or Pyle National Type FS or FSC for shallow devices and Type FD or FDC for deep devices. Boxes for ceiling mounted light fixtures shall have approved no-bolt fixture studs. Boxes used as junction boxes shall have beveled edge flat steel blank cover.
- K. Where outlet boxes are mounted exposed in unfinished areas, (where approved by the engineer) surface mounted boxes shall be 4-inches square, have rounded corners and 1/2-inch raised steel cover plates.
- L. Location of outlets on small drawings is approximate and exact dimensions for locations of outlets shall be as taken from large scale plans and details on drawings or as directed by the Architect/Engineer.
 - 1. Outlets shall be located generally from column centers and finished wall lines or to center of wall or joints between wall panels. Ceiling outlets shall be installed at elevation of suspended ceiling connected to outlets in ceiling or slab above. Where necessary to fit and center with panel or ceilings and wall spaces, the contractor must, at no expense the Owner, shift the lighting outlets or other outlets as required by the Architect.
- M. Bracket lights over mirrors shall be centered on mirrors with 2-inch fixture clearance above mirror.
- N. Boxes for switches and receptacles installed in columns shall be located off center to allow for future partitions.
- O. Boxes for switches at or near door shall be installed on the side opposite the hinge. Verify door swing direction prior to rough-in.

- P. To prevent sound from traveling through walls, electrical devices from different rooms shall not be mounted in the same stud place. Through-wall boxes shall not be used. In fire rated walls or partitions, outlet boxes on opposite sides of walls or partitions shall be separated by a horizontal distance of 24-inches. Outlet boxes larger than 4-inch square shall not be installed in fire rated walls or partitions. Verify location of fire rated walls or partitions with Architectural drawings prior to rough-in.
- Q. Mark all junction boxes and pull boxes and/or the conduit where it enters the box with panel designation and circuit number in permanent, black marker. Mark on the outside where located in unfinished spaces and mark on the inside in finished spaces.
- R. Verify exact location of floor boxes and poke-throughs with Architect prior to rough-in.

3.12 TELEPHONE, CABLE TV, COMMUNICATIONS, SECURITY AND OTHER SYSTEMS CONDUIT:

- A. These specifications include the furnishing of all labor and materials necessary for the complete installation of a system of conduits, outlets, and boards for use by the system suppliers.
- B. This installation must be done according to the requirements of the system suppliers and the general specifications covering "Light and Power" herewith.
- C. Provide and install pull boxes at all locations as required by the system suppliers. Mark all pull boxes and/or the conduit where it enters the box with type of system in permanent, black marker. Mark on the outside where located in unfinished spaces and mark on the inside in finished spaces.
- D. Provide and install conduit sleeves thru floors and walls as required by the system suppliers.
- E. The systems shall be provided with main service conduit sized as indicated on drawings. Each phone, data or TV location requires 1-inch empty conduit with pull rope unless noted otherwise. Conduits shall be routed to nearest associated telephone or data terminal board or above lay-in ceiling. If ceiling is an air return plenum, cables shall be routed completely in conduit or must be rated for use in air return plenum. Verify conditions of job prior to rough-in.
- F. Outlets:
 - 1. All wall outlets shall be installed with standard square box, plates furnished by system suppliers, or as directed. All outlets to be located as directed. Outlet boxes not used shall be provided with blank covers.
- G. Install the raceway system as shown on drawings.
- H. All conduit ends shall be equipped with non-metallic insulated bushings.
- I. All 2, 3 and 4-inch conduits within buildings shall include pull boxes after every two 90 degree bends. Size per NFPA 70 Article 370.

- J. Terminate conduit runs to/from the associated telephone or data backboard in a closet or designated space at the top or bottom of the backboard. Conduits shall enter closets next to the wall and be flush with the backboard.
- K. Where drilling is necessary for vertical conduits, locate holes so as not to affect structural sections such as ribs or beams.
- L. All empty conduits located in equipment closets or on backboards shall be sealed with a standard non-hardening duct seal compound to prevent the entrance of moisture and gases and to meet fire resistance requirements.
- M. Conduit runs shall contain no more than four quarter turns (90 degree bends) between pull boxes/backboards.
- N. Furnish and install nylon pull rope in all empty conduits. (Sleeves through floor/wall are exceptions).

3.13 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES:

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from ½-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finish grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes with bottom below frost line.
- E. Where conduits enter side of enclosures, field-cut openings for conduits according to manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.14 COLOR CODING OF BOXES, ENCLOSURES, CONDUIT AND RACEWAYS:

- A. All boxes, enclosures, conduit and raceways, shall be color coded as follows:
 - 1. Other Systems:
 - a. Fire Alarm: Red

END OF SECTION

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

- A. Section includes:
 - 1. Lighting and appliance branch-circuit panelboards.

1.3 SUBMITTALS:

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage surge suppressor, 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, include the following information:
 - 1. Dimensional data.
 - 2. Enclosure type, per NEMA 250.
 - 3. Detailed bus configuration, including current and voltage ratings.
 - 4. Short-circuit current rating of panelboard and overcurrent protective devices.
 - a. Where series ratings are permitted and utilized, submit evidence of series ratings for each selected combination of fuses and/or circuit breakers.
 - 5. Evidence of NRTL listing for series rating of installed devices.
 - 6. Detailed features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Layout or elevation of each panelboard showing the relative locations of all specified breakers, lugs, accessories, and features.
 - 8. Wiring diagrams for power, signal, and control wiring.
- C. Operation and Maintenance Data: Include operation and maintenance data for all panelboards and components in the operation and maintenance manuals. Data shall include, but not be limited to:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Summary of final settings for all adjustable overcurrent protective devices.
 - 3. Print or copy of all final panel schedules in 8.5" x 11" format.
- D. Test Records: Submit the following test records to the Engineer for review and approval, and include in the operation and maintenance manuals:

1. Load Balancing: Submit records of load readings before and after load balancing, per paragraph ADJUSTING in Part 3 of this Section.

1.4 QUALITY ASSURANCE:

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.
- B. Product Selection for Restricted Space: Drawings may indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with any indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1 and NFPA 70.

1.5 COORDINATION:

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates wall 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 requires clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of any concrete bases with actual equipment provided.

1.6 PROJECT CONDITIONS:

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions:
 1. Notify in writing, not fewer than seven/days in advance of proposed interruption of service.
 2. Do not proceed with interruption of electric service without written permission.
 3. Comply with NFPA 70E.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS:

- A. All panelboard components shall be the product and assembly of the same manufacturer. All similar units of all panelboards shall be of the same manufacturer.
- B. All panelboards shall be completely factory assembled with molded case circuit breakers or switches.
- C. Panelboards shall have main breaker, main switch, or main lugs, voltage, bus sizing, and flush or surface mounting as indicated on the Drawings.
- D. Enclosures: Flush or surface mounted as indicated on the Drawings
 1. Rated for environmental conditions at installed location:

- a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
2. Cabinets:
 - a. Finish shall be galvanized steel.
 - b. Shall not have ventilation openings for panels with bus ratings of 225 amperes or less.
 - c. Back and sides shall be fabricated from one piece of formed steel for lighting and appliance branch-circuit panelboards.
 - d. Shall contain a minimum of four interior mounted studs and necessary hardware for “in” and “out” adjustment of panel interior.
 - e. Gutter sizes for cabinets containing through-feeders shall be increased by the amount required for auxiliary gutters in the NEC.
 - f. For multi-section flush-mounted panelboards, all cabinets shall be the same height.
 3. Front Trim:
 - a. Shall include frame and door with concealed hinges.
 - b. Shall be secured to cabinet with screws. Trim clamps are not allowed.
 - c. Shall be galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer’s standard two-coat, baked-on finish consisting of prime coat and thermosetting top coat.
 - d. Shall be same width and height as cabinet for surface-mounted panels. Shall overlap cabinet by at least 0.75 inches for flush-mounted panels.
 - e. Shall not have ventilation openings for panels with bus ratings of 225 amperes or less.
 - f. Shall include a welded angle on the rear to support and align trim to cabinet.
 - g. Shall be separate for each section of multi-section panelboards. For flush installations, trims and doors of all sections shall be the same height.
 - h. All trims for circuit breaker panelboards with bus ratings of 600 amperes or less shall be hinged trim construction with a concealed piano hinge on the right side. Trim shall be able to be hinged open by operating a latch or removing no more than four (4) screws.
 4. Doors:
 - a. Shall be galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer’s standard two-coat, baked-on finish consisting of prime coat and thermosetting top coat.
 - b. Shall be provided with concealed butt hinges welded to the doors and trim.
 - c. In making switching devices accessible, doors shall not uncover any live parts.
 - d. Shall have metal directory card holder with transparent protective cover for card, permanently mounted to inside of door.
 - e. Shall have the manufacturer’s standard flush lock. All panels shall be keyed to match existing keys used within building installed.

E. Phase, Neutral, and Ground Buses:

1. Material shall be plated copper or aluminum, with copper connection straps bolted together and rigidly supported on molded insulators.
 2. Phase bus bars for panels with single pole branches shall be arranged for sequential phasing of branch circuit devices.
 3. Phase bus bar connections for breakers with trip settings of 100 amperes and less shall be arranged so that a two-pole breaker may be substituted for two single-pole breakers, and a three-pole breaker may be substituted for three single-pole breakers, without any modifications to the bus bars or connecting straps.
 4. Protective devices shall be able to be replaced without removing adjacent units or main bus connectors, and without drilling or tapping. Panel phase bus connections to protective devices shall be field removable by means of a screwdriver.
 5. Neutral bus shall be full sized. Neutral bus shall be rated for 200 percent of phase bus ampacity for panels fed from K-Factor Rated transformers and as indicated on the Drawings.
 6. Equipment ground bus shall be bonded to cabinet, and shall have adequate terminals and lugs for all branch circuit and feeder equipment grounding conductors.
 7. In multi-section panelboards, the bussing in each section shall be full size. In all except the final section, provide sub-feed line-side lugs or feed-through load-side lugs for cable connections to the other sections. Sections with tapped bus or cross-over bus shall not be accepted.
 8. Coordinate lug quantities and sizes with the feeders serving the panel, as scheduled on the Drawings.
- F. Future Devices: Where designated on panel schedule or one-line diagram as “space” or “future”, include all mounting brackets, bus connections, filler plates, and necessary appurtenances necessary for installation of devices.
- G. Panelboard Short-Circuit Current Rating:
1. Refer to the Drawings for required A.I.C. ratings for each panelboard.
 2. Panelboards shall bear a UL label indicating the integrated equipment rating.
 3. Rating Options:
 - a. Fully rated panelboards and circuit breakers.

2.2 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS:

- A. Shall comply with the GENERAL REQUIREMENTS FOR PANELBOARDS listed above.
- B. 240 Volt Panelboards: Subject to compliance with requirements, provide product from one of the following list of manufacturers and types:
 1. Siemens Infrastructure and Cities (Siemens IC): P1
 2. Square D by Schneider Electric: NQOD
- C. Shall comply with NEMA PB 1, lighting and appliance branch-circuit type.
- D. Branch Overcurrent Protective Devices: Shall be bolt-on circuit breakers, replaceable without disturbing adjacent units.

- E. Doors: Shall have flush latch. For doors over 36" in height, provide two latches.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES:

A. Molded Case Circuit Breaker (MCCB):

1. Molded Case Circuit Breakers shall comply with the requirements specified in Section "Overcurrent Protective Devices".
2. Circuit breakers shall be factory-installed in the panelboards in the same numbered positions indicated on the Drawings.
3. Thermal-Magnetic or Non-Adjustable Electronic Trip Molded Case Circuit Breakers shall be provided for all panelboard circuit breakers less than 400 amperes, unless noted otherwise.
4. Where indicated on the drawings breaker shall be provided with a handle blocking clip, allowing the breaker to be blocked in the "ON" position.

B. Fused Switch:

1. Fused switches shall comply with requirements specified in Section "Enclosed Switches and Circuit Breakers".
2. Fuses shall comply with requirements specified in Section "Overcurrent Protective Devices".

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- B. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

- A. Where indicated on the Drawings, install panelboards on concrete bases, in addition to attaching them to the vertical finished or structural surface behind the panelboard.
- B. Install wall-mounted panelboards so that the maximum height of the highest circuit breaker or switch above the finished floor does not exceed 78 inches. The bottom of the cabinet shall not be less than 6 inches above the finished floor.
- C. Mount panelboard cabinet plumb and rigid, without distortion of the box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- D. Arrange panelboard sections for easy removal without disturbing other sections. Locate sections so that present and future conduits can be conveniently connected. Coordinate sizes of cabinets with the designated installation space.

- E. Where flush-mounted panelboards are specified, install one 3/4-inch empty conduit into an accessible ceiling space for every three single-pole spare breakers or breaker spaces, for future use.
- F. Multi-section panelboards shall be coupled together by conduit nipples appropriately sized for all feeder wiring installed between the sections.
- G. Where multi-section panelboards are flush-mounted, sections shall be arranged side by side and shall be 1.5 inches apart.
- H. Arrange conductors in gutters into neat groups and bundle and wrap with nylon cable ties.
- I. At the direction of the Architect or Engineer, where panelboards are installed in public areas, paint the exposed surfaces of the trims, doors, and cabinets to match surrounding wall finishes after the panelboards are installed.

3.3 IDENTIFICATION

- A. Identify all field-installed conductors, interconnect wiring, and components.
- B. Panelboard Nameplates: Label each panelboard with a nameplate as indicated on the Drawings and as specified elsewhere.
- C. Create a type-written schedule of circuits in each panelboard, after approval of the Engineer, and install in the directory holder in each panelboard.
 - 1. Circuit descriptions shall include final room numbers, room descriptions, and items or equipment served.
 - 2. Spare breakers and breaker spaces shall be neatly marked in pencil, to allow for future updates of the schedule.
 - 3. Schedules shall be typed on paper directory cards, or printed on card stock appropriately sized for the directory sleeves provided on the panel door.

3.4 ADJUSTING:

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Load Balancing: If the contractor modifies the circuiting arrangement from what is shown on the plans, the contractor shall be responsible for balancing the loads between phases. The maximum difference of load between phases shall not exceed 20%. Submit calculations to the engineer for review.

END OF SECTION

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY:

- A. This section includes the furnishing, installation, and connection of wiring devices.
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Weather-resistant receptacles.
 - 3. Snap switches.

1.3 DEFINITIONS:

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.

1.4 ADMINISTRATIVE REQUIREMENTS:

- A. Coordination:
 - 1. Receptacles for Owner Furnished Equipment: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.

1.5 ACTION SUBMITTALS:

- A. Product Data (Where indicated in Section “Common Work Results for Electrical”, provide the following information): For each type of product.
- B. Shop Drawings (Where indicated in Section “Common Work Results for Electrical”, provide the following information): List of legends and description of materials and process used for premarking wall plates.

1.6 CLOSEOUT SUBMITTALS:

- A. Operational and Maintenance Data: For wiring devices to include all manufacturers’ packing label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 GENERAL WIRING DEVICE REQUIREMENTS:

- A. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.
- B. 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.
- C. Comply with NFPA 70.

2.2 RECEPTACLES:

- A. Comply with NEMA WD 1, NEMA WD 6, and UL 498.
- B. LIST OF ACCEPTABLE RECEPTACLE MANUFACTURERS

Manufacturer:	Volt	Hubbell / Kellems	Leviton	P&S	Bryant	Cooper Wiring Devices
1. Specification Grade:						
Duplex:	20 A. 125 V.	5352A	5352	5362	BRY5362	5352
Ground Fault:	20 A. 125 V.	GFRST20	G5362-WT	2097	---	---
Tamper Resistant:	20 A. 125 V.	BR20TR	---	TR63	---	TR5362
Weather Resistant:	20 A. 125 V.	5362WR	---	---	---	---
Tamper Resistant Ground Fault:	20 A. 125 V.	GFTRST20	G5362-WT	2097TR	---	---
Weather Resistant Ground Fault:	20 A. 125 V.	GFWRST20	G5362-WT	2097TRWR	---	---

- C. Weatherproof duplex receptacles shall be weather resistant GFCI grounded duplex receptacles.
 - 1. All receptacles shall be mounted with the same orientation (horizontal or vertical). When a different orientation is required or desired, obtain permission from the Architect/Engineer prior to rough-in.
 - 2. Damp Locations: Provide with a single weatherproof coverplate.
 - 3. Wet Locations: Provide “In-Use” extra-duty non-metallic weatherproof cover.
 - a. Taymac #MM42OC
- D. See plans for Special Outlet Schedule.
- E. Receptacle body shall be formed of high-impact nylon faced thermoplastic or urea and receptacle contacts shall be Bronze. Hard use industrial specification grade receptacles shall have a one piece brass bridge with integral ground contacts.
- F. When only one receptacle is connected to a 20 amp circuit by itself, that receptacle must be rated 20 Amp.
- G. All receptacles shall be self-grounding with ground lug.

- H. Install receptacles to clear all cabinets, equipment, etc.
- I. Color of receptacles: Ivory. Color of receptacles on the emergency system: Red. Verify colors with Architect prior to ordering.
- J. All 120V, 15 or 20A receptacles located, within kitchens, within 6 feet of a sink, exterior locations, per NFPA 70 and as located on the plans shall be ground fault circuit interrupters (GFCI) for personnel protection (Class A) with 5ma trip. Feed through GFCI receptacles or GFCI breakers may be used to protect other receptacles in the same room and on the same circuit if wired per the manufacturer's recommendations. Prior to final inspection, perform ground fault test on each protected receptacle and submit list of all receptacles tested with results to the Engineer. Label receptacles that are GFCI protected by another feed through GFCI receptacle or by GFCI breaker "GFCI protected".
- K. Provide duplex receptacle on separate circuit beside each location of communications equipment requiring 120V, power.
- L. All 15 and 20 amp, 125 or 250 volt non-locking receptacles in damp or wet locations should be listed as "weather resistant".

2.3 PENDANT CORD-CONNECTOR DEVICES:

- A. Description:
 1. Matching plug and receptacle body connector.
 2. Body: Nylon with screw-open, cable-gripping jaws and provisions for attaching external cable grip.
 3. External Cable Grip: Woven wire mesh type made of high-strength, galvanized steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.4 CORD AND PLUG SETS:

- A. Description:
 1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket, with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
 3. Plug: Nylon body and integral cable clamping jaws. Match cord and receptacle type for connection.

2.5 TOGGLE SWITCHES:

- A. Wall Switches: Wall switches in general, used to control lighting shall be quiet operating.
- B. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- C. Switches shall be single pole, two-pole, three-way, four-way, keyed, and with pilot light as called for on the drawings. Groups of switches shall be under one gangplate. Where switches are in fire rated walls groups of switches shall be maximum of two (2) gangs under one cover plate.

D. Switches shall be as follows unless specified otherwise.

Single Pole	20 A. 120 V. / 277 V.
Two Pole	20 A. 120 V. / 277 V.
Three-Way	20 A. 120 V. / 277 V.
Four-Way	20 A. 120 V. / 277 V.
Key Switch	20 A. 120 V. / 277 V.

E. When only one switch is connected to a 20 amp circuit by itself, it must be rated 20A.

F. All switches shall be self grounding w/ground lugs.

G. LIST OF ACCEPTABLE SWITCH MANUFACTURERS

Manufacturer:	P&S	Hubbell / Kellems	Leviton	Bryant	Cooper Wiring Devices
Specification Grade Switches	PS 20AC Series	HBL 1220 Series	1220 Series	4901	AH 1220 Series

H. Color of switches: Ivory. Color of switches on the emergency system: Red. Verify colors with Architect prior to ordering.

2.6 WALL PLATES:

A. Wall plates shall be flexible (non-breakable) nylon or polycarbonate.

B. Wall plates in maintenance areas and other high abuse areas shall be stainless steel.

C. Nylon plate color shall be Ivory unless otherwise specified. Nylon plate color for devices on the emergency system shall be Red unless otherwise specified. Verify colors with Architect prior to ordering. Nylon plate manufacturer shall be the same as the device manufacturer so that colors match.

D. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.

E. Provide plates (either device specific or blank if no device is to be provided at certain locations) for all telephone, cable TV, communication, and security outlets.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Installation shall be in accordance with NFPA 70, and as shown on the drawings.

B. Comply with NECA 1.

C. Switches shall be located on the latch side of all doors. If switches must be located on the hinge side of a door, they shall be located so that they are not behind the door when it is open. All questionable locations shall be brought to the Engineers/Architects attention.

D. Verify all outlet locations on the job prior to rough-in. Locations may be altered up to 6'-0" in any direction without additional cost to the Owner.

- E. When conductors larger than #12 AWG are used on 15A or 20A circuits, splice #12 AWG pigtails for device connections.
- F. Install ground pin up on vertically mounted receptacles and install ground pin to the right on horizontally mounted receptacles.

3.2 FIELD QUALITY CONTROL:

- A. Convenience Receptacles:
 - 1. Verify ground continuity.
 - 2. Verify correct polarity of hot and neutral conductors.

END OF SECTION

SECTION 26 28 10 - OVERCURRENT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

- A. Section includes:
 - 1. Cartridge fuses rated 600 VAC and less for use in control circuits, enclosed switches, panelboards, switchboards, and enclosed controllers.
 - 2. Plug fuses rated 125 VAC and less for use in enclosed switches and fuseholders.
 - 3. Molded Case Circuit Breakers (MCCBs)
 - 4. Molded Case Switches

1.3 DEFINITIONS:

- A. MCCB: Molded Case Circuit Breaker

1.4 SUBMITTALS:

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, and descriptions of individual components.
 - 1. Dimensions and manufacturer's technical data on features, performance, and electrical characteristics.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (both interrupting and withstand, as appropriate).
 - 4. Evidence of UL listing for series rating of installed devices.
- B. Operation and Maintenance Data:
 - 1. Manufacturer's written instructions for testing, operating, and adjusting overcurrent protective devices.
 - 2. Summary of final settings for all adjustable overcurrent protective devices.

1.5 QUALITY ASSURANCE:

- A. Source Limitations: Obtain overcurrent protective devices, components, and accessories, within same product category, through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for the intended locations and application.
- C. Comply with NFPA 70.
- D. Comply with NEMA FU 1 for cartridge fuses.

- E. Comply with UL 248-11 for plug fuses.
- F. Comply with UL 489 for circuit breakers.

1.6 COORDINATION:

- A. Coordinate overcurrent protective device ratings with utilization equipment nameplate limitations of maximum fuse and/or breaker size and with system short-circuit current levels.
- B. Final fuse sizes for mechanical and other motor loads shall be selected by the fuse manufacturer to provide Type-2 “no damage” protection for equipment served. Contractor shall provide and install the selected fuses.

1.7 EXTRA MATERIALS:

- A. Furnish extra materials that match products installed and that are packaged in protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity of installed fuses for each size and type but no fewer than three for each size and type.

PART 2 - PRODUCTS

2.1 FUSES:

- A. Manufacturers: Subject to compliance with requirements, provide product from one of the following list of manufacturers:
 - 1. Cooper Bussmann, Inc.
 - 2. Edison Fuse, Inc.
 - 3. Mersen Electrical Power
 - 4. Littelfuse, Inc.
- B. Cartridge Fuses:
 - 1. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
 - 2. Fuse Classes:
 - a. Class-CC: UL 248-4, time-delay, rejection type
 - b. Class-J: UL 248-8, dual-element, time-delay
 - c. Class-L: UL 248-10, dual-element, time-delay
- C. Plug Fuses:
 - 1. Characteristics: UL 248-11, dual-element, time-delay, Edison base.

2.2 MOLDED-CASE CIRCUIT BREAKERS:

- A. Shall be provided as factory installed components of panelboards or switchboards, or as separately enclosed units, as specified in other Sections or on the Drawings.

- B. Manufacturers: Subject to compliance with requirements, provide product from one of the following list of manufacturers:
1. Siemens Infrastructure and Cities (Siemens IC)
 2. Square D by Schneider Electric
- C. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- D. Standard Features and Accessories:
1. Standard frame sizes, trip ratings, and number of poles.
 2. Line connections shall be bolt-on.
 3. Lugs: Mechanical type, suitable for the trip rating, number and size of conductors, and conductor material.
 4. Multi-pole units shall be enclosed in a single housing or be factory-assembled to operate as a single unit. They shall have a trip element for each pole, a common trip bar for all poles, and a single operator.
 5. Operating handle shall indicate ON, TRIPPED, and OFF positions.
 6. Shall be 80% rated, unless 100% rating is shown on the Drawings or is otherwise specified.
 7. Application Listing: Appropriate for application:
 - a. Type SWD for switching fluorescent lighting loads.
 - b. Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - c. Type HACR for feeding heating, air conditioning, and refrigeration equipment.
- E. Optional Features and Accessories: Provide where indicated on the Drawings or otherwise specified.
1. Ground-Fault Protection: Relay and trip unit with push-to-test feature.
 2. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- F. Thermal-Magnetic (or Non-Adjustable Electronic Trip) Circuit Breakers:
1. Shall have inverse time element for low-level overloads.
 2. Shall have instantaneous magnetic trip element for short circuits.
 3. Shall have front-mounted, field-adjustable magnetic trip setting for circuit-breaker frame sizes 250 amperes and larger. Factory setting shall be LO, unless otherwise noted.
- G. Current-Limiting Circuit Breakers: Frame sizes 400 amperes and smaller; shall have let-through ratings less than NEMA FU 1, RK-5.
- H. Ground-Fault Circuit Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (5-mA trip) with self-test circuitry.
- I. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).

2.3 MOLDED-CASE SWITCHES:

- A. Manufacturers: Subject to compliance with requirements, provide product from one of the following list of manufacturers:
 - 1. Siemens Infrastructure and Cities (Siemens IC)
 - 2. Square D by Schneider Electric
- B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame interrupting rating.
- C. Features and Accessories:
 - 1. Standard frame sizes and number of poles.
 - 2. Lugs: Suitable for the trip rating, number and size of conductors, and conductor material.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Examine overcurrent protective devices before installation. Reject units 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 overcurrent protective devices of sizes and with characteristics appropriate for each piece of equipment.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS:

- A. Cartridge Fuses:
 - 1. Motor branch circuits: Class-J for up to 600 A; Class-L for over 600 A
 - 2. Single-phase motor and other branch circuits where appropriate fuse holders are specified in other Sections: Class-CC
- B. Plug Fuses:
 - 1. Motor and other branch circuits: Edison-base type.

3.3 CIRCUIT BREAKER APPLICATIONS:

- A. Refer to applicable Drawings and Specification Sections for information on types of circuit breakers to be installed in particular applications. Applicable Sections may include, but not be limited to, "Panelboards", and "Enclosed Switches and Circuit Breakers".

3.4 INSTALLATION:

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.5 IDENTIFICATION:

- A. Install labels complying with requirements found on the Drawings and elsewhere in this Specification. Install labels at every fused switch and each fuse block, socket, or holder which indicate fuse replacement information

END OF SECTION

SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

- A. Section includes:
 - 1. Fusible Switches
 - 2. Nonfusible Switches
 - 3. Toggle Type Switches
 - 4. Fustats
 - 5. Enclosed Circuit Breakers
 - 6. Enclosures

1.3 DEFINITIONS:

- A. NC: Normally closed
- B. NO: Normally open

1.4 SUBMITTALS:

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, factory setting, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work. Include wiring diagrams for power, signal, and control wiring.
- C. Operation and Maintenance Data: Include operation and maintenance data for all enclosed switches and circuit breakers in the operation and maintenance manuals. Data shall include, but not be limited to:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.5 QUALITY ASSURANCE:

- A. Source Limitations: Obtain enclosed switches and circuit breakers, components, and accessories, within same product category, through one source from a single manufacturer.

- B. Product Selection for Restricted Space: Drawings may indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for the intended locations and application.
- D. Comply with NFPA 70.

1.6 COORDINATION:

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and requires clearances for equipment access doors and panels.

1.7 PROJECT CONDITIONS:

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions:
 - 1. Notify in writing, not fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of electric service without written permission.
 - 3. Comply with NFPA 70E.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES:

- A. Manufacturers: Subject to compliance with requirements, provide product from one of the following list of manufacturers:
 - 1. Siemens Infrastructure and Cities (Siemens IC)
 - 2. Square D by Schneider Electric
- B. Type GD General Duty switches are not allowed.
- C. Type HD, Heavy Duty, Single Throw, 1200 A and smaller: UL 98 and NEMA KS 1.
 - 1. Shall be horsepower rated for the load served.
 - 2. Shall have clips or bolt pads to accommodate the specified fuses, with rejection features to reject fuses other than those specified.
 - a. Refer to Section “Overcurrent Protective Devices” for specified fuse types.
 - 3. Shall have an external operating handle indicating ON and OFF positions, with provisions to padlock the switch in the OFF position.
 - 4. Shall have a mechanical interlock to prevent the opening of the cover unless the handle is in the OFF position. This interlock shall be defeatable with a special tool to permit inspection.
 - 5. Shall have an equipment ground kit. Equipment ground shall be internally mounted and labeled for copper and aluminum ground conductors.

6. Accessories: Provide where indicated on the Drawings or required to complete the intended design.
 - a. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

2.2 NONFUSIBLE SWITCHES:

- A. Shall meet all requirements for FUSIBLE SWITCHES above, except that they shall not accept fuses.

2.3 TOGGLE TYPE SWITCHES:

- A. Shall be installed where indicated on the Drawings or elsewhere in the Specifications.
- B. Shall be 20 A, 30 A, 40 A, or 60 A, one, two, or three poles, voltage and horsepower rated for the load served.
- C. Shall be provided with matching steel coverplate, with provisions for padlocking the switch in the OFF position.
- D. Shall be provided with an appropriately sized mounting box where other than a standard outlet box is necessary for switch installation.

2.4 FUSTATS:

- A. 120 V motor loads up to 0.5 horsepower: Shall be horsepower rated, and include an Edison-base fuse holder and integral toggle switch. Where located in damp or wet locations, provide weatherproof unit equal to Bussman #SSN.
- B. 120 V motor loads, 0.75 horsepower: Shall consist of a horsepower rated Edison-base fuse holder, with a separate horsepower rated toggle switch mounted adjacent to fuse holder.
- C. 120 V motor loads, 1 horsepower, or 277 V motor loads: Shall consist of a horsepower and voltage rated manual motor starter switch and a horsepower and voltage rated fuse holder designed to hold a time-delay Class CC rejection-type fuse.
 1. Manual motor starter switch: NEMA ICS 2, general purpose, Class A, with quick-make, quick-break toggle action, marked to indicate ON, OFF, and TRIPPED. Shall include an ambient-compensated type overload relay with inverse-time characteristics and NEMA ICS 2, Class 10 tripping characteristics. Shall have heaters and sensors in each phase, matched to nameplate full-load current of specific motor it protects and appropriately adjusted for duty cycle.

2.5 ENCLOSED CIRCUIT BREAKERS:

- A. Circuit breakers shall comply with Section "Overcurrent Protective Devices".
 1. Shall be Thermal-Magnetic or Non-adjustable Electronic Trip Molded-Case for breakers less than 400 amperes, unless noted otherwise.
 2. Shall be adjustable Electronic Trip Molded-Case for breakers 400 amperes and larger, unless noted otherwise.

2.6 ENCLOSURES:

- A. Comply with NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50.
- B. Enclosure Types: Shall be compatible with environmental conditions at installed locations, unless more stringent requirements are specified on the Drawings or elsewhere in the Specifications.
 - 1. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
- C. Finished Spaces: In finished spaces, enclosures shall be flush mounted unless otherwise noted.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated. Maximum mounting height and required working clearances shall comply with NFPA 70.
- B. Install fuses in fusible devices.
 - 1. Where fuses serve utilization equipment or motors, coordinate final fuse sizes with equipment nameplates and comply with listed minimum and maximum sizes.
 - 2. Plug fuses installed in fustats shall be sized for 125 percent of the nameplate full load amps or running load amps.
- C. Comply with NECA 1.

3.3 IDENTIFICATION:

- A. Identify field-installed conductors, interconnecting wiring, and components.
- B. Label each enclosure with engraved nameplate.

3.4 ADJUSTING:

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION

SECTION 26 29 00 – MOTORS

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section applies to all motors that are not directly specified or when referenced by other sections.

PART 2 - PRODUCTS

2.1 MOTORS:

- A. For alternating current, fractional and integral horsepower motors. Fed. Spec. CC-M-1807, NEMA Publications MG1 and MG2 shall apply.
- B. Voltage ratings shall be as follows:
 - 1. Single phase:
 - a. Motors connected to 120 volt systems: 115 volts.
 - b. Motors connected to 208 volt systems: 200 volts.
 - c. Motors connected to 240 volt or 480 volt systems: 230/460 volts, dual connection.
 - 2. Three phase:
 - a. Motors connected to 208 volt systems: 200 volts.
 - b. Motors, less than 100 HP, connected to 240 volt or 480 volt systems: 230/460 volts, dual connection.
 - c. Motors, 100 HP or larger, connected to 480 volt systems: 460 volts.
- C. Number of phases shall be as follows:
 - 1. Motors, 1/2 HP and less: Single phase, 120 volt.
 - 2. Motors, larger than 1/2 HP: 3 phase, 480 volt (208 or 240 volt when 480 volt distribution not used).
 - 3. Exceptions:
 - a. Hermetically sealed motors.
 - b. Motors for equipment assemblies, less than one HP, may be single phase provided the manufacturer of the proposed assemblies cannot supply the assemblies with three phase motors.
- D. Horsepower ratings shall be adequate for operating the connected loads continuously in the prevailing ambient temperatures in areas where the motors are installed, without exceeding the NEMA standard temperature for the motor insulations.
- E. Motor designs, as indicated by the NEMA code letters, shall be coordinated with the connected loads to assure adequate starting and running torques.
- F. Motor Enclosures:

1. Shall be the NEMA types shown on the drawings for the motors.
 2. Where the types of motor enclosures are not shown on the drawings, they shall be the NEMA types which are most suitable for the environmental conditions where the motors are being installed.
 3. Thoroughly clean and paint the enclosures at the factory with manufacturer's prime coat and standard finish.
- G. Additional requirements for specific motors, as indicated in other sections, shall also apply.
- H. Energy-Efficient Motors: When higher than standard efficiency motors are specified or indicated, they shall be rated using the IEEE Standard No. 112, Method B, test procedures, as detailed in NEMA MG1, 12.53.a. The nameplate shall identify the NEMA Nominal Efficiency indicated on the drawings.
- I. Motor Connected and Controlled by Variable Frequency Drives.
1. Motors shall be NEMA Design "B", and U.L. Listed inverter duty rated motors for "PWM" drives with motor winding heater overloads.
 2. Motors shall comply with NEMA MG1, Part 31 and can withstand the stress of 1600V peak with a 0.1 m second rise time.
 3. Connect cooling fans as required via the variable frequency drive. Provide controls, contactors, and wiring as required.
 4. Motors shall be provided with a shaft grounding ring, except for motors located in a hazardous environment.
 - a. A maintenance free, circumferential, conductive micro fiber shaft grounding ring (SGR) to discharge shaft currents to ground. The conductive microfibers shall redirect shaft currents and provide a reliable, very low impedance path from shaft to motor frame by-passing motor bearings entirely.
 - b. Vertical turbine pump motor, the upper shaft shall be provided with a coating to isolate the shaft from the bearings. The shaft grounding ring shall be installed within the motor casing. This information shall be provided with the shop drawings submittal for verification of method of installation and to ensure they are to be supplied.
 - c. Each motor shall be provided with SGR by the motor manufacturer or equipment manufacturer and shall not be field installed.
 - d. All motors sizes up to 100 h.p. (75kW) shall be guaranteed not to fail due to electrical bearing fluting damage, during the motor warranty period.
 - e. Each motor equipped with this device shall be provided with an externally mounted tag stating that a SGR is installed.
 - f. Method of installation shall be as recommended by manufacturer however, epoxy mounted SGR's shall not be used.
 - g. Device shall have the following features:
 - 1) Protect motor and attached equipment.
 - 2) Provide long term effectiveness.
 - 3) Easy to install.
 - 4) Contamination proof.
 - 5) Effective at any R.P.M.
 - 6) Maintenance free operation.

- h. After each motor is installed, the contractor shall have a 3rd party test the installation to ensure no VFD induced shaft voltages are present and provide written documentation of the successful test results. If the testing is not successful, the installation shall be corrected prior to putting the motor into service. The testing must be performed with a Fluke 199C Scope Meter and the appropriate accessories for testing while the motor is in operation.

- J. E Frame Energy Efficient Motors: All equipment provided with E frame motors shall have a performance controller as manufactured by “Performance Control” provided and installed in addition to the across the line starter in all cases except when motor is controlled by a variable frequency drive.

2.2 POWER FACTOR:

- A. Each motor as indicated in Section POWER FACTOR CORRECTION shall be supplied at 95% power factor by the equipment supplier or power factor correction, meeting the requirements of Section POWER FACTOR CORRECTION - shall be provided by the power factor to 95%. (Exception: this does not apply to motors controlled by frequency drives.)

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Installation shall be in accordance with the NEC, as shown on the drawings, and as required by other sections of these specifications.

END OF SECTION

SECTION 26 29 23 - MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section includes all motor starters and motor control stations, either stand alone in NEMA enclosures, combination type with disconnect, or in panelboards.
- B. All starters shall be protected by a time delay 'J' fuse providing Type '2'. No damage protection. Submit specific fuse to be used on this project and manufacturing information to indicate required protection.

PART 2 - PRODUCTS

2.1 NEMA RATED MOTOR STARTERS:

- A. Approved manufacturers: Square D by Schneider Electric, and Siemens Infrastructure and Cities (Siemens IC). NEMA and NEC shall apply.
- B. All starters shall be fully NEMA rated, shall have all components made by one manufacturer, and shall have the following features:
 - 1. Enclosed type as shown on the drawings.
 - 2. Safety switches within the motor controller enclosures shall have external operating handles with lock-open padlocking provisions and shall indicate the ON and OFF positions.
 - 3. Motor control circuits:
 - a. Shall operate at not more than 120 volts.
 - b. Shall be grounded except as follows:
 - 1) Where isolated control circuits are shown.
 - 2) Where manufacturers of equipment assemblies recommend that the control circuits be isolated.
 - c. Incorporate a separate, heavy duty, control transformer within each motor controller enclosure to provide the control voltage for each motor operating over 120 volts.
 - d. Incorporate two primary and one secondary time delay fuses for control power transformers sized in accordance with NEC and UL requirements.
 - 4. Overload current protective devices:
 - a. Electronic type Class 10 or Class 20 selectable, set to Class 20 trip.
 - b. Shall be 3 pole.
 - c. Manual reset on the door of each motor controller enclosure.
 - d. Overloads shall be field adjusted and set for the associated motor's rated full load current.
 - e. Check every motor controller after installation and verify that correct sizes of protective devices have been installed.

5. H-O-A selector switch, Red "on" pilot light and a minimum of One N.O. auxiliary contact (field convertible to N.C.).
 6. Other devices and accessories as shown on the drawings or otherwise required by control drawings and approved shop drawings.
 7. Enclosures:
 - a. Shall be NEMA 1 for interior, NEMA 3R for exterior and other types as shown on the drawings for the motor controllers.
 - b. Where the types of motor controller enclosures are not indicated, they shall be the NEMA types which are the most suitable for the environmental conditions where the motor controllers are being installed.
 - c. Doors shall be mechanically interlocked to prevent opening unless the breaker or switch within the enclosure is open.
 - d. Thoroughly clean and paint the enclosures at the factory with manufacturer's prime coat and standard finish.
 8. Each controller for motors 10 HP and larger shall be equipped with a 3 phase sensing loss of phase relay with automatic reset. Equal to Time Mark model 258.
- C. Motor controllers incorporated with equipment assemblies shall also be designed for the specific requirements of the assemblies.
- D. Additional requirements for specific motor controllers, as indicated in other sections, shall also apply.
- E. Install a disconnect safety switch near and within sight of each motor. Combination type switch/starter in one enclosure is acceptable if listed as one piece. Switches shall comply with Section 262816.
- F. E Frame Energy Efficient Motors: All equipment provided with E frame motors shall have a performance controller as manufactured by "Performance Control" provided and installed in addition to the across the line starter in all cases except when motor is controlled by a variable frequency drive.
- G. If motor is dual winding, provide three additional phase conductors of the same size and type as specified to the starter, and provide the proper type of starter for the motor supplied. Increase conduit as required.

2.2 TRANSISTORIZED VARIABLE FREQUENCY DRIVE:

- A. The Variable Frequency Drive (VFD) shall be for use with a standard NEMA B induction motor. All units are to be started up at the jobsite by a factory trained authorized representative and a one year parts and labor warranty. Manufacturer shall be AC Tech, Allen-Bradley, Square D by Schneider Electric, Siemens Infrastructure and Cities (Siemens IC), General Electric, Danfoss, Yaskawa, ABB and must include the following:
1. Individual or simultaneous operation of the VFD's shall not add more than 5% total harmonic voltage distortion to the normal bus, nor more than 10% while operating from standby generator (if applicable) per IEEE 519, 1992. The main service disconnect shall be the point of common coupling. The short circuit current at point of common coupling under utility operation shall be verified with the Utility Co. or as shown on one-line diagram.

- a. Maximum allowable total and individual harmonic current distortion limits for each odd harmonic shall not exceed limits as set forth by IEEE 519, 1992. If harmonic filters are required to meet these requirements, the VFD manufacturer must provide the filter, and is responsible for the design and manufacturing of the filter.
2. Input displacement power factor of .95 or higher at all operating speeds and loads.
 3. The VFD shall be a microprocessor based digital Pulse Width Modulated (PWM) design. Current source designs and SCR-type units are not acceptable.
 4. The VFD shall be supplied with an input AC line reactor of 5% impedance. Line reactor shall be designed to address performance issues of NEMA MG1-20.55 and to provide proper transient protection of the VFD input power devices. Line reactor is to be factory mounted and wired within the VFD enclosure.
 5. The VFD shall be equipped with a load AC line reactor of 5% impedance built-in or motor termination filter to prevent voltage rate of rise, reflective voltage amplitude damage, and other potential damage to motor windings and bearings. The manufacturer shall review the drawings for motor types and cable distances and provide all protection required for the specific application.
- B. The PWM VFD shall provide the following design features as standard.
1. Microprocessor logic. The VFD shall be microprocessor based and utilize digital input for all parameter adjustments. Use of potentiometers for parameter adjustment is not acceptable. Provide digital communications interface with the building automation system and include all required programming coordination with the controls subcontractor.
 2. Auto restart. The VFD shall automatically attempt to restart after a malfunction or an interruption of power. The number of attempted restarts shall be customer selectable (0 to 5). If the drive reaches the limit of restarts without successfully restarting and running for a customer selectable length of time (60 to 600 seconds), the restart circuit shall lockout and shall provide contact annunciation. Delay between attempts to restart shall be customer selectable from 3 to 300 seconds.
 3. Current limit. A current limit circuit shall be provided to limit motor current to a present adjustable maximum level by reducing the drive operating speed or acceleration rate when the limit is reached. Range of adjustment shall be from 50 to 100 percent.
 4. Digital output displays and input parameter programming. The VFD shall include a digital display and digital input programming capability on the main logic board. The display shall be programmable for indication of output speed in rpm, frequency, and percent of base speed, motor amps, output motor volts, and output load. The display shall also function as a first fault indicator.
 5. The VFD shall provide terminals for connecting normally closed remote safety devices. This emergency shutdown shall operate in any mode of operation.
 6. Critical frequency avoidance (Frequency jump points). The VFD shall provide a minimum of two (2) selectable frequency jump points, in 1.5 Hz increments, to be used to avoid critical resonance frequencies of the mechanical system.
 7. Input signal follower. The input signal follower circuit shall have selectable differential inputs and accept an electrical speed command from an external source rated at 0-5, 4-20 or 10-50 mA or voltage signals of 0-5 or 0-10 VDC. The input follower circuit shall be capable of operating directly or inversely proportional to the listed speed commands.

8. Motor overload protection. Electronic motor protection shall be provided which is capable of predicting motor winding temperature based on inputting specific parameters including motor design type (TEFC, ODP, or other) and speed range. The protection shall provide an orderly shutdown should the motor's thermal capabilities be exceeded. This protection also eliminates the requirement for motor overload relays on single motor applications when a bypass is not used.
9. Open collector outputs. The VFD shall include three (3) open collector outputs to indicate drive run, drive fault, and drive ready.
10. Output signals. The VFD shall include analog output signals for output load, output speed, and motor voltage. The signals shall be 0 to 10 Vdc @ 1 mA.
11. Stop mode functions. The VFD stopping mode functions shall be selectable for coast-to-rest or stopping at programmed decel rate.
12. V/Hz profiles. The VFD shall provide up to eight (8) selectable V/Hz profiles.
13. Loss of control signal. The VFD shall revert to the last speed on loss of input control signal. Owner shall be able to field select a preset speed for the VFD to run when control signal is lost, if preferred. In either case, an open collector output shall be selected to indicate loss of control signal for remote indication purposes.

C. The PWM VFD design shall provide the following:

1. Input section. Full wave rectification shall be achieved with input diodes in a conventional bridge configuration and shall be used to supply voltage to the DC bus.
2. DC bus. The DC shall be filtered by a series choke between the input section and one or more capacitors to provide ripple free dc current. An additional series choke shall be located between the bus capacitors and the inverter to provide enhanced output short circuit and ground fault protection. VFDs which use only bus capacitors require that input isolation transformers or input line filters be supplied.
3. Output section. The inverter shall use IGBT transistors to provide three phase output power to the motor.
4. All printed circuit boards shall be manufactured using surface mount technology. They shall be conformal coated.

D. The VFD supplier shall provide the same design/technology to cover the HP range for all VFDs. VFD supplier to provide the following documentation:

1. Documentation showing that the VFD is the same basic design.
2. One Instruction Manual to cover the full HP range for all VFDs.
3. Explanation of commonality of spare parts for all VFDs.

E. Output ratings. The VFD shall operate within the following ratings:

1. Frequency range, 1-120 Hz
2. Frequency resolution, .1 percent of base speed with analog input .025 percent with digital input
3. Frequency accuracy within .05 percent of set point
4. Overload rating, 110 percent for one minute

F. Motor performance.

1. The VFD shall provide 3 percent speed regulation.
2. Input power. The VFD shall operate within the following parameters:

- a. 208V (+5%/-10%), or 230V (+5%/-10%), or 480V (+5%/-10%)
- G. Set-up adjustments. Standard setup adjustments shall include:
1. Minimum speed, 0 to 100 percent
 2. Maximum speed, 0 to 100 percent
 3. Linear accel, .5 to 600 seconds
 4. Linear decel, .5 to 600 seconds
 5. Maximum output voltage, adjustable
 6. V/Hz, adjustable with selectable profiles
 7. Current limit, 50 to 110 percent
- H. Environmental ratings. The VFD shall operate within the following parameters without the requirement for derating:
1. Operating temperature, 0 degree C to 40 degrees C
 2. Altitude to 100m (3300 ft.)
 3. Humidity, 95 percent non-condensing
- I. Enclosure. The drive shall be furnished in a NEMA enclosure most suitable for the installed environment. Finned heatsinks and/or cooling fans shall be provided as necessary for proper heat dissipation. Inlet filters are required on all cooling fans, unless they are outside the drive enclosure and no circulated air passes circuit boards, transistors, or other electrical components.
- J. Codes and standards. The VFD shall meet the following standards.
1. CSA
 2. ETL (UL 508)
 3. NEMA
 4. NEC
- K. Protective features. The VFD shall be designed to meet the following specifications and operate within the following parameters:
1. AC input fuses. The VFDs power circuit shall be fused and isolated internally with respect to ground. Fuses shall provide a minimum of 100,000 A interrupting capacity and shall provide complete Type 2 protection, not allowing any damage to the VFD upon overload or short circuit.
 2. Logic common. The power unit's logic common shall be at ground potential.
 3. Phase loss protection. Phase loss protection shall be provided to prevent single phasing.
 4. Phase loss ride-through. The VFD shall be capable of continued operation during an intermittent loss of power for 0.1 seconds (6 cycles). Opening of the VFDs input and/or output line switches while operating shall not result in damage to the power circuit components.
 5. Short circuit and ground fault protection. The VFD shall have an instantaneous electronic trip circuit to protect the VFD from output line-to-line and line-to-ground short circuits. The VFD must be capable of withstanding short circuits at 480V plus 10 percent (528V). The VFD supplier must demonstrate ground fault and short circuit protection at time of start up or plant witness test. The VFD shall be capable of providing 110 percent motor current intermittently.

The VFD shall include an instantaneous overcurrent trip and shall not restart after electronic overcurrent trip until reset through the run/stop circuit, or unless the auto restart function has been enabled.

6. Transient and surge voltage protection. Transient and surge voltage protection shall be provided through the use of Metal Oxide Varistors (MOVs). The VFD shall withstand a 6000 volt, 80 joule surge voltage when tested in accordance with ANSI/IEEE C62.41-1980 with the test circuit adjusted for a 2100 amp peak 8x20 microseconds short circuit discharge current pulse.
 7. Rotating Motor Start. The VFD shall be able to start into a motor rotating in either direction and at any speed, and accelerate to set speed without any time delay, tripping or component loss.
 8. Load side disconnects. A disconnect switch may be used on the load side of the VFD near the motor for ease of service and safety. Operating the switch with the VFD running shall not cause any component failure. In dual motor applications, VFD shall be able to operate either motor with the other motor disconnected without requiring jumpers, parameter modifications, or other adjustments. As part of start-up, VFD supplier shall certify all load side disconnects can be opened or closed with drive running at full speed without damage to the drive.
- L. Reliability: A complete description of supplier's Quality Assurance and Testing program shall be provided.
1. Component testing. All power semiconductors and integrated circuits shall be 100 percent tested.
 2. Computerized ATE testing. Computerized Automated Testing Equipment (ATE) testing shall be used to evaluate functional performance of printed circuit boards. Printed circuit boards shall receive a thermal stress test where temperatures are cycled between 0 degree C and 65 degrees C and receive electrical power-on and power-off cycle tests.
 3. Burn in. All VFDs shall be tested/run in the equivalent of a NEMA 1 enclosure and burned in at rated ambient (40°C) with a fully loaded motor.
- M. Maintainability.
1. All control circuit voltages (12VAC, 24VDC, 160VDC and 120VAC) shall be physically and electrically isolated from power circuit voltages (200 to 600VAC, 600VDC) to ensure safety to maintenance personnel.
 2. The VFD shall be furnished with an alphanumeric diagnostic display with fault indications to include the following: bus overvoltage, bus undervoltage, overcurrent, over temperature, ground fault, and timed overload.
 3. All printed circuit boards shall utilize quick disconnect plugs and/or pull apart terminal blocks to facilitate maintenance by providing quick change-out without disconnecting terminal strip connections thereby reducing wiring errors.
 4. VFD shall be capable of starting and operating without a motor connected for ease of service.
 5. All setup and operating parameters shall be stored in nonvolatile memory. The static memory module shall be to be removed and installed in replacement logic boards with all setup and operating parameters intact requiring no adjustment of replacement boards.
- N. Additional features.

1. Operator panel.
 - a. A door-mounted Soft touch Operator Panel shall be included with the following features:
 - b. Shall digitally display motor speed, load, amps, and output volts (and controller setpoint and system pressure when setpoint controller is included).
 - c. Shall indicate drive run, drive ready, drive fault, plus operator function/status indication such as auto speed reference, and auto restart.
 - d. Shall provide selection for Hand/Off/Auto control. In Hand mode, the VFD shall be started and stopped from the operator's panel. In the Auto mode, the VFD shall be started and stopped by remote contact closure. In the Off mode, the VFD shall be locked out.
 - e. Shall provide selection for Manual/Auto Speed Reference. In the Manual Reference mode, the VFD speed reference shall be set from the operator's panel. In the Auto Reference mode, the VFD speed reference shall be set by the external source instrument signal. Selecting between Manual and Auto speed reference shall have no bearing on the Hand/Off/Auto start/stop selector, or vice versa.
 - f. Shall name all parameters in English, not codes or numbers.
 - g. Keypad shall include electronic lock-out feature to prevent unauthorized personnel from parameter access.
 - h. Shall store up to six drive faults in a history batch file in the order they occur to simplify trouble-shooting. This file will automatically be updated should new faults occur.
2. A 120 V. control transformer fused on both the primary and the secondary.
3. Disconnect switch. The operating mechanism shall be designed so that the door can be padlocked in the "OFF" position. The switch shall have an interrupting capacity of 65,000 symmetrical amperes.
4. Communications port. A communications port for RS 232C or RS 422 communications.
5. Provide factory start up, adjustment, and initialization.
6. On-site owner training of at least 4 //16// hours shall be provided, and must include a complete description on Theory of Operation, Operating Procedures, Functional and Operating Characteristics of Specific Logic Boards, Troubleshooting, Repair, and Preventative Maintenance. A simulated failure shall be diagnosed. All costs for instructor's time, travel, meals, lodging, etc. shall be included.
7. *Provide controls, contactors, and wiring as required for motor cooling fans.

2.3 SOLID STATE REDUCED VOLTAGE STARTER:

- A. Solid-state motor starters shall provide voltage ramp with current limit and reduced voltage soft starting of any standard NEMA design a.c. induction motor of the appropriate horsepower. The starter must be self contained and house the solid state controller, motor overload protection, and disconnect means, in one enclosure.
- B. Manufacturers:
 1. Unit(s) must be manufactured by Eaton, Allen Bradley, Square D by Schneider Electric, General Electric, or Siemens Infrastructure and Cities (Siemens IC).
 2. Unit(s) must be approved or certified by the following agencies:

- a. UL
- b. CSA

C. Product Construction:

1. Units must be in NEMA enclosures suitable for the environment they are installed or as shown on the drawings and house the solid state reduced voltage controller, motor overload protection, disconnect device, properly sized bypass contractor as required in one enclosure.
2. Cooling fans shall be ball bearing type with internal impedance protection for the motor. If cooling fan(s) are used, an over temperature sensor shall be supplied with a normally closed contact which opens at or below 85 degrees C.
3. Units smaller than 450 Amps shall be sized such that they will fit inside of a 20-inches wide, 20-inches deep motor control center section. Larger units shall fit inside of a 30-inches wide, 20-inches deep motor control center section.
4. Line and load terminals shall be mountable for wire termination from the top or bottom.
5. All set-up adjustments must be conveniently located on the front cover of the controller (not enclosure). These adjustments must be clearly marked on the cover of the controller to show function and direction of adjustment. LED indicators shall be provided to indicate Control Power On, Motor On, Motor Starting, and Shorted SCR.
6. Power poles and logic assemblies to be removable as one piece assemblies. One logic assembly shall work in any size unit of a given line voltage. The logic assembly and SCRs shall be noise immune per NEMA showering arc test for solid-state contactors.

D. Electrical:

1. Voltage Ratings
 - a. 200 volts, 60 Hz
 - b. 230 volts, 60 Hz
 - c. 460 volts, 60 Hz
 - d. Input voltage variations
 - 1) ± 15 percent of nominal motor voltage, at a frequency of 58 to 62 Hz
2. Power Requirements provide 120 volt control transformer.
3. Provide a properly sized bypass/shorting contactor.
4. Operating Temperature:
 - a. 0 to 50 degrees C (32° to 122°F) without derating
 - b. 0 to 70 degrees C (32° to 158°F) derating 33 percent for every 10 degrees C over 50 degrees C to a maximum of 70 degrees C
5. Humidity:
 - a. 5 to 95 percent relative humidity, non-condensing
6. Overload Ratings @ 50 degrees C:

<u>%FLA</u>	<u>Duration (sec)</u>
600	10
450	30
300	120
200	480
115	Continuous

7. UL Short Circuit Withstand Ratings: 600 V. 100 KVA
 - a. With Fusible Disconnect: Starter shall be protected by time delay 'J' fuses providing Type 2 no damage protection.

8. Duty Cycle:
 - a. Twenty (20) times in any 60 minute period. Control rating to be 133 percent of motor rating.
 - b. Five (5) times in any 60 second period. Control rating to be 200 percent of motor rating.
 - c. Ten (10) times in any 60 second period. Control rating to be 300 percent of motor rating.

9. Phase Rotation:
 - a. Unit shall not be phase rotation sensitive

10. Power Devices:
 - a. Power semiconductors shall be SCRs connected in inverse parallel configuration in each phase.
 - b. PIV Ratings shall be 2.5 times nominal line voltage rating of units:
 - 1) 200V units : 600V PIV
 - 2) 230V units : 600V PIV
 - 3) 460V units : 1200V PIV
 - c. Firing circuitry must utilize op to isolated gate circuitry for hard firing of SCRs. Pulse transformers and "picket fence" firing are not acceptable. The gate drive circuit shall be optically coupled for noise immunity and long life.

11. Voltage Transient Suppression:
 - a. MOVs (Metal Oxide Varistors) shall be supplied as standard across the power devices to protect them from line transients. The MOVs shall clamp transient voltages to 10 percent below the PIV of the power devices. Voltage transient suppression shall not cause the power devices to turn on.
 - b. Resistor-capacitor snubbed networks shall be supplied as standard to prevent the power devices from misfiring due to the dv/dt characteristics of the SCRs.

12. Noise Immunity:

- a. Units shall be noise immune per NEMA ICS 2-230 Showering Arc Test at 2000V peak.

13. I/O Ratings:

- a. Output contacts shall have NEMA B300 ratings

- 1) Auxiliary contact
- 2) Over temperature switch
- 3) Shorted SCR contact

- b. Inputs:

- 1) Logic board: 120V, 40VA max.
- 2) Coil: 120V, 10VA max.
- 3) Ramp Selects: Dry contact closure only - no input power required.

E. Functionality:

- 1. Unit shall provide a reduced voltage start of the closed loop voltage ramp type adjustable over a range of 30 to 90 percent of nominal line voltage at turn-on and with a ramp time range of 1/2 to 30 seconds.
- 2. Two (2) separately adjustable voltage ramps and a ramp down on decel function shall be supplied as standard. Each selectable ramp shall have an Initial Torque and a Start Time adjustment. "Light duty" controllers are not acceptable.
- 3. An energy saving circuit shall be supplied as standard to optimize energy efficiency of lightly loaded motors and shall be based on the NASA/Nola principle.
- 4. A motor voltage regulator (line voltage limiter) adjustment shall be supplied as standard to prevent higher than motor nameplate voltage from being applied to the motor when the incoming line voltage rises above the motor nameplate voltage.
- 5. A shorted SCR detector shall be supplied with an interlock contact that will prevent starting of a device with shorted SCRs when wired into the control circuit in the appropriate position or may be used as an alarm driver.

F. Adjustments:

- 1. Initial Torque 1 Adjustment Range - 30 - 90 percent of nominal voltage
- 2. Start Time 1 Adjustment Range - 0.5 - seconds
- 3. Initial Torque 2 Adjustment Range - 30 - 90 percent of nominal voltage
- 4. Start Time 2 Adjustment Range - 0.5 - 30 seconds
- 5. Line Voltage Limiter Adjustment Range - 80 - 120 percent of nominal voltage
- 6. PFC Circuit Adjustment Range - 60 - 100 percent of nominal voltage

G. I/O Points:

- 1. Inputs:

- a. Motor Run Coil
- b. Ramp 1, Ramp 2, Common, and Decel - selection is made as a connection of a dry contact between the desired input and Common

- 2. Outputs:

- a. N.O. Auxiliary Contact
- b. N.C. Over temperature Switch
- c. N.C. Shorted SCR Detected

3. Diagnostics:

- a. Control Power On LED
- b. Motor Power On LED
- c. Motor Starting LED
- d. Shorted SCR LED

PART 3 - EXECUTION

3.1 **INSTALLATION:**

- A. Installation shall be in accordance with the NEC, and as shown on the drawings.

END OF SECTION

SECTION 26 35 33 - POWER FACTOR CORRECTION

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This Section applies to all motors and capacitors that are specified other sections of this specification and/or Division 26.

1.2 ALL MOTORS FURNISHED FOR THIS PROJECT 10 HP AND LARGER SHALL HAVE POWER FACTOR CORRECTION PROVIDED AND INSTALLED TO CORRECT THE POWER FACTOR TO 95% WITH THE EXCEPTION OF MOTORS CONTROLLED BY FREQUENCY DRIVES.

1.3 APPROVED MANUFACTURERS:

- A. Square D by Schneider Electric.
- B. Eaton Electrical, Inc.; Cutler-Hammer Business Unit.

PART 2 - PRODUCTS

2.1 POWER FACTOR CORRECTION CAPACITORS:

- A. Ratings: Voltage, phase, and KVAR shall be as shown on plans or as determined by the equipment supplier to convert the power factor to 95 percent.
- B. Standards: Capacitor(s) shall be UL listed and designed for installation in accordance with Article 460 of the 1996 National Electrical Code.
- C. Type: Capacitor(s) shall be industrial grade assemblies consisting of individual capacitor cells factory assembled and wired in a heavy duty steel enclosure.
- D. Losses: Typical losses shall not exceed 0.5 W/KVAR.
- E. Capacitor Cells: Capacitor(s) shall be of individual cell construction and utilize polypropylene film as the dielectric. Electrodes shall consist of metalized aluminum layers vacuum deposited to the polypropylene film dielectric. Each capacitor cell shall be furnished with a built-in UL recognized pressure sensitive interrupter and filled with a completely biodegradable fluid. Cells shall be self-healing.
- F. Discharge Resistors: Resistors shall be furnished to reduce the residual voltage to 50 volts or less within one minute after the capacitor has been disconnected from the line.
- G. Enclosure: Enclosures shall be fabricated from sheet steel and be suitable for indoor or outdoor use as required for equipment location. Enclosure shall be designed to contain any fluid that might escape from the capacitor cells. Integral mounting brackets shall be provided for either wall or floor mounting.
- H. Capacitor shall have 20 year rated life.
- I. Fuses:

1. Each capacitor branch circuit shall be individually fused, on the line side of the contactor with current limiting Class 'J' fuses having an interrupting capacity of 200,000 symmetrical amperes. Fuses shall be rated to protect the contactor, capacitor and interconnecting wiring. All capacitor branch circuit fuses shall be mounted in Class 'J' fuseholders.

PART 3 - INSTALLATION

3.1 MOTORS:

- A. Install capacitors per manufacturer recommendations and per N.E.C. at the motor location. Connect to the load side of the motor overload. Adjust the size of the starter overloads to match the motor amps with the capacitor. Verify connection requirements with the capacitor manufacturer for all reduced voltage starters.
- B. Solid State Starters: Capacitors must be connected to a separate disconnect or breaker in the panel which feeds the motor ahead of the controller. Provide and install the required disconnect and fuses or breaker. Install a contactor in line with the capacitor to disconnect the capacitor when the motor is off. Provide control wiring to auxiliary contacts in the starter. The rating of the disconnect, fuses and capacitor shall not be less than 135 percent of the rated capacitor current.
- C. Conductors: All conductors connecting capacitors shall have a minimum ampacity of 135 percent of the rated current of the capacitor.

END OF SECTION

SECTION 26 51 00 - BUILDING LIGHTING

PART 1 - GENERAL:

1.1 DESCRIPTION:

- A. This section includes the furnishings, installation of and connection of all building lighting.

1.2 DEFINITIONS:

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including LED module, reflector, and housing.

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES:

- A. Shall conform to the detail drawings, NEC Article 410 and UL-57.
- B. Approved Manufacturers: Provide products of firms regularly engaged in the manufacturer of lighting fixtures of types and rating required, whose products have been in satisfactory use in similar service for not less than 5 years. The manufacturer of the lighting fixtures shall comply with the provisions of the appropriate code and standards. All fixtures shall be pretested before shipping.
- C. UL or CSA US Listing: All fixtures shall be manufactured in strict accordance with the appropriate and current requirements of the "Standards for Safety" to UL 8750 or others as they may be applicable. A listing shall be provided for each fixture type, and the appropriate label or labels shall be affixed to each fixture in the position concealing it from normal view.
- D. Specifications and scale drawings are intended to convey the salient features, function and character of the fixtures only, and do not undertake to illustrate or set forth every item or detail necessary for the work.
- E. Sheet Metal:
 - 1. Shall be formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved), and parallel to each other as designed.

2. Wireways and fittings shall be free of burrs and sharp edges and shall accommodate internal and branch circuit wiring without damage to the wiring.
 3. Where lighting fixture types are detailed with minimum 20 gauge (0.035 inch) housing, minimum 22 gauge (0.029 inch) housings will be acceptable provided they have strengthening embossed rib and break formations, and meet the rigidity test requirements of Fed. Spec. W-F-1662.
 4. When installed, any exposed fixture housing surface, trim frame, door frame and lens frame shall be free of light leaks; lens doors shall close in a light tight manner.
 5. Hinged door closure frames shall operate smoothly without binding when the fixture is in the installed position, and latches shall function easily by finger action without the use of tools.
- F. LED Drivers shall be serviceable while the fixture is in its normally installed position, and shall not be mounted to removable reflectors or wireway covers unless so specified.
- G. Recessed fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.
- H. Light fixtures with louvers or light transmitting panels shall have doors with hinges, latches and safety catches to facilitate safe, convenient cleaning and relamping.
- I. Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by screws, chains, captive hinges or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.
- J. Metal Finishes:
1. The manufacturer shall apply a standard finish (unless otherwise specified) over a corrosion resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking.
 2. Interior light reflecting finishes shall be white with not less than 85 percent reflectances, except where otherwise shown on the drawing.
 3. Exterior finishes shall be as shown on the drawings.
- K. LED Drivers:
1. Driver shall be serviceable while the fixture is in its normally installed position, and shall not be attached to removable reflectors or wireway covers unless so specified.
 2. Disconnecting Means: Each LED fixture installed in an indoor location shall have a disconnecting means either internal or external to the fixture, to disconnect simultaneously from the source of supply all conductors of the driver, including the grounded (neutral) conductor if any. The line side terminals of the disconnecting means shall be guarded. The disconnecting means shall be located so as to be accessible to qualified persons before servicing or maintaining the driver. The disconnecting means is required for new light fixtures.
 3. All drivers shall be labeled or listed by UL or ETL. Case marking shall also indicate the required supply voltage, frequency, RMS current, current surge during

starting, input watts, and power factor at the designed voltage, open circuit voltage, crest factor and efficacy.

4. Submit, simultaneously with shop drawings, a certified test report by an independent testing laboratory showing that the ballasts/drivers meet or exceed all the performance requirements in this specification.
5. LED Drivers:

a. General Requirements: Unless otherwise indicated, features include the following:

- 1) Voltage Range: +/- 10 percent of rated input.
- 2) Total Harmonic Distortion Rating: ≤ 20 percent.
- 3) Power Factor: ≥ 95 Percent.
- 4) UL Class 2 output.
- 5) Line Frequency: 60 Hz.
- 6) Inrush Current: Per NEMA 410.
- 7) Ambient Temperature Range: 0°C to 25°C.
- 8) Maximum Case Temperature: 90°C.
- 9) Sound Rating: Class A or better.
- 10) Integral Short Circuit, Open Circuit, and Overload Protection: IEEE C82.41.2
- 11) Electromagnetic Compliance: FCC Title 47, Part 15, Class A.

L. Provide all lighting fixtures with a specific means for grounding their metallic wireways and housings to an equipment grounding conductor.

M. Lighting Transmitting Components for LED Fixtures:

1. Shall be 100 percent virgin acrylic plastic and nominal .125 inch thick. Styrene lenses shall not be provided for any fixture.
2. Unless otherwise specified lenses and diffusers shall be retained firmly in a metal frame by clips or clamping ring in such a manner as to allow expansion and contraction of the lens without distortion or cracking. At final inspection, all lens that sag or do not lay down flat and lens that sag shall be replaced by the manufacturer.

2.2 LED MODULES:

A. LED Modules:

1. LED modules shall include the following features unless otherwise indicated:
 - a. Comply with IES LM-79, LM-80, LM-82 and TM-21 requirements.
 - b. Minimum CRI 80 and minimum color temperature of 3500 K unless otherwise specified in LIGHTING FIXTURE SCHEDULE.
 - c. Minimum Rated Life: IES L70 = 50,000 hours.
 - d. Light output lumens as indicated in the LIGHTING FIXTURE SCHEDULE.
 - e. LED chips shall be wired so that failure of one chip does not prohibit operation of the remainder of the chip array.

2. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
3. Color shift over 6,000 hours shall be <0.007 change in U'V' as demonstrates in the IES LM-80-08 testing report.

2.3 EMERGENCY LIGHTING AND POWER:

- A. When emergency battery power packs are optional to the specified exit signs and emergency fixtures and are not included in the model number in the light fixture schedule, the emergency battery power packs shall be included as part of the specified fixture when they are not connected to an emergency generator system. Verify on drawings.
- B. Emergency operation of fixtures:
 1. Fixtures shown in the fixture schedule or lighting plans as an emergency fixture shall be supplied with a factory installed sealed replaceable nickel cadmium battery and a solid state inverter charger and switch systems.
 2. All components shall be contained within the fixture. The emergency battery system shall operate two lamp (1100 lumen minimum) for a minimum of 90 minutes. Battery charger shall be capable of recharging batteries to full charge within 24 hours after complete discharge. Fixture shall contain pilot light to indicate charger condition and a test switch to simulate power failure. Systems shall be unconditionally guaranteed for three (3) years by the factory. Unit to be Underwriters Laboratory listed and labeled as an emergency unit. Units shall be by Iota Engineering, Bodine, Sure-Lites or equal.
- C. Exit Signs and Other Emergency Fixtures:
 1. Provide emergency battery power packs on all exit signs and emergency fixtures that are not connected to an emergency generator.
 2. Batteries shall be lead calcium, pure lead, or nickel cadmium. Lead acid will not be accepted. Batteries shall be unconditionally guaranteed for 5 years with a 10 year prorated warranty from the factory. Units shall be Underwriter's Laboratory listed and labeled as an emergency unit. Batteries shall be provided as standard or as optional equipment of the same series of the specified fixtures.
 3. The emergency Battery Section shall be connected on the same circuit as the light ahead of any switches or contactors controlling area lights so that emergency lighting is maintained at all times.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Installation shall be in accordance with the NEC, and as shown on the drawings.
- B. Align, mount and level the lighting fixtures uniformly.
- C. Avoid interference with and provide clearance for equipment. Where the indicated locations for the lighting fixtures conflict with the locations for equipment, change the locations for the lighting fixtures by the minimum distances necessary as approved by the Engineer.

- D. For suspended lighting fixtures, the mounting heights shall provide the clearances between the bottoms of the fixtures and the finished floors as shown on the drawings. Verify all heights with the Architect prior to mounting.
- E. Lighting Fixture Supports:
1. Provide adequate support for light fixtures. Supports may be anchored to channels of the ceiling construction, to the structural slab or to structural members above a suspended ceiling or to structural members within a partition (for wall mounting).
 2. Maintain the fixture positions after cleaning and relamping.
 3. Support the lighting fixtures without causing the ceiling or partition to deflect.
 4. Hardware for recessed LED fixtures:
 - a. For suspended ceiling systems and plaster frame construction, hardware devices such as bolts, screws or rivets shall be used to secure the fixture to the ceiling system structural members. Listed clips indentified for use with the type of ceiling framing member(s) and light fixture(s) shall also be permitted.
 - b. Fixtures shall be secured to the ceiling system at not less than each of the four corners with additional support and/or connection as required to resist spreading of the support members and to safely lock the fixture into the ceiling system.
 5. Hardware for surface mounting LED fixtures to suspended ceilings:
 - a. In addition to being secured to any required outlet box, fixtures shall be bolted to a grid ceiling system at four points spaced near the corners of each fixture. The bolts shall be not less than 1/4-inch secured to channel members attached to and spanning the tops of the ceiling structural grid members. Non-turning studs may be attached to the ceiling structural grid members or spanning channels by special clips designed for the purpose, provided they lock into place and require simple tools for removal.
 - b. In addition to being secured to any required outlet box, fixtures shall be bolted to a plaster ceiling at four points spaced near the corners of each fixture. Prepositioned 1/4-inch studs or threaded plaster inserts secured to ceiling structural members shall be used to bolt the fixtures to the ceiling. In lieu of the above, 1/4-inch toggle bolts may be used on new or existing ceiling provided the plaster and lath can safely support the fixtures without sagging or cracking.
 6. Provide safety supports from fixture housing up to structure above for all fixtures weighing more than 15 lbs. Supports shall be chains, aircraft cable, factory or field fabricated and rated in excess of twice the weight of the fixture.
- F. Contractor shall coordinate between the electrical and ceiling trades to ascertain approved lighting fixtures are furnished in the proper sizes and installed with the proper devices (hangers, clips, trim frames, flanges), to match the ceiling system being installed. Lay-in type fixture installed in sheet rock ceilings shall be provided with a flange and bolted to the ceiling.
- G. Connection to all fixtures mounted in lay-in ceilings shall be as follows: Provide J-Box supported from structure at 12-inches above fixtures for connections. Install UL listed 3/8-

inch or 1/2-inch flexible conduit whip down to each fixture. Each whip shall be field cut to length to allow fixture to be relocated 4-foot-0-inches in any direction. Whips shall include 2 or 3 #12 Cu. THHN/THWN conductors (numbers as indicated) and a #12 ground. Fixtures supplied with UL listed whip shall be supplied with ground conductors.

END OF SECTION

SECTION 27 05 01 - COMMON WORK RESULTS FOR LOW VOLTAGE SYSTEMS CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Installation of raceways, conduit sleeves etc. as required for routing of low voltage systems cabling shall be per specifications Section "RACEWAY SYSTEMS".

1.2 SUMMARY:

- A. The extent of the low voltage systems cabling work is indicated by drawings, details and other specification sections. Low voltage systems cabling installation is hereby defined to include, but not be limited to the installation of cabling for voice, data, CCTV, fire alarm, access control, lighting, and temperature control systems.
- B. All cabling materials and associated equipment shall be provided by the Contractor. The Contractor shall be responsible for all testing as specified in individual specifications sections.
- C. It is the intent of the Drawings and Specifications to provide a complete workable telecommunication cabling system ready for the Owner's use. Any item not specifically shown on the Drawings or called for in the Specification, but normally required for a complete system, are to be considered a part of the contract and is the responsibility of the Contractor.

1.3 SUBMITTALS:

- A. Product Data: Provide submittals for each type of product specified with this section, including but not limited to cable supports, cable wraps, fire rated sleeves, etc.
- B. Statement of Warranty
- C. Manuals and Technical "Documents"
- D. Record Drawings

1.4 COORDINATION:

- A. The Contractor will cooperate and coordinate with the Owner to minimize conflict with Owner's operations.
- B. Coordinate with other building trades and electrical work including wires and cables, electrical boxes and fittings, and raceways to properly interface installation of systems with other work.

- C. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- D. Sequence installation of low voltage systems cabling with other work to minimize possibility of damage and soiling during remainder of construction.
- E. Contractor will be responsible for ceiling tile replacement, wall repainting, etc. due to damage caused by installation of this equipment and cabling.

1.5 PERFORMANCE AND QUALITY ASSURANCE:

- A. National Fire Protection Association:
 - 1. NFPA 70: National Electrical Code.
 - 2. NFPA 75: Standard for the Fire Protection of Information Technology Equipment.
- B. Underwriters Laboratories, Inc. (UL):
 - 1. UL 486A-91: Wire connectors and soldering lugs for use with copper conductors.
 - 2. UL 1449-85: Transient voltage surge suppressors.
 - 3. UL 1863: Communications - Circuit Accessories
 - 4. UL 813: Commercial Audio Equipment
- C. Telecommunications Industry Association (TIA):
 - 1. ANSI/TIA-568-C.0-1-2010 and addenda “Generic Telecommunications Cabling for Customer Premises”.
 - 2. ANSI/TIA-568-C.1-2-2011 and addenda “Commercial Building Telecommunications Cabling Standard”.
 - 3. ANSI/TIA-568-C.2 and addenda “Balanced Twisted-Pair Telecommunications Cabling & Component Standard”.
 - 4. TIA-160: Sound Systems.
 - 5. TIA-299A: Loudspeakers, Dynamic Magnetic Structures and Impedance.
 - 6. CEA-310-E “Design Requirements for Cabinets, Panels, Racks, and sub-Racks”.
 - 7. SE-101-A: Amplifier for Sound Equipment.
 - 8. SE-103: Speakers for Sound Equipment.
- D. Federal Communications Commission (FCC):
 - 1. FCC Regulations, Part 15 Title 47.
- E. Maintenance Qualifications:
 - 1. Experienced in manufacturing equipment of the types and capacities specified for this project.
 - 2. Equipment has a record of successful in-service performance.
- F. Contractor Qualifications:
 - 1. Established communications and electronics contractor for at least five (5) years.
 - 2. Authorized distributor for the equipment supplied with full manufacturer's warranty privileges.

3. Maintains a fully equipped service organization capable of providing full maintenance and service of the installed system within twenty four (24) hours.
 4. Maintains the necessary spare parts in the proper proportion as recommended by the manufacturer to maintain and service the equipment being installed.
- G. Manufacturer's Instructions: Comply with all installation instructions and methods recommended or required by the manufacturer.

1.6 EQUIPMENT AND MATERIALS:

- A. Contractor shall install low voltage systems cabling per the system manufacturer recommendations or requirements or as otherwise specified on the drawings or elsewhere in the specifications.
1. The Manufacturers and Products specified in this document are to be used. No substitutions of components specifically referenced will be allowed without approval prior to bid.
 2. All products and materials shall be new, clean, free of defects and free of damage and corrosion.
 3. All products installed will meet or exceed the minimum performance requirement as listed in the technical specification of this document and its corresponding addendums.

1.7 WORKMANSHIP:

- A. All work shall be done in a workman like fashion. All equipment and materials are to be installed in a neat and secure manner, while cables are to be properly dressed. Workers must clean any debris and trash at the close of each workday.
- B. No substitution of product or services will be accepted without prior approval from both the Owner and the Manufacturer providing the Application warranty.

1.8 DELIVERY, STORAGE, AND HANDLING:

- A. Delivery: Deliver low voltage system equipment and components in factory-fabricated containers or wrappings, which properly protect equipment from damage.
- B. Storage: Store low voltage system equipment and components in original packaging. Store inside in a well-ventilated space protected from weather, moisture, soiling, humidity, extreme temperatures and vandalism. Protection against vandalism will be at the Contractor's expense. Storage recommendations by manufacturer shall be followed.
- C. Handling: Handle low voltage system equipment and components carefully to prevent damage, breaking, and scoring of finishes. Do not install damaged units or components; replace with new.

1.9 AS-BUILT DRAWINGS:

- A. Show on black line prints in red ink all low voltage cable system jack identification numbers, actual cable routing paths, as well as all changes from original plans made during the installation. Separate As-Built drawings shall be provided for each low voltage system installed. Return the "as-built" red lined drawings, specifications and addenda, as set forth in the General conditions, to the Architect/Engineer upon completion of the project.

PART 2 - PRODUCTS

2.1 BACKBOARDS:

- A. Backboards shall be provided as needed or as required or recommended by low voltage systems manufacturer. Field verify exact quantity and sizes needed. Backboards shall meet the following requirements.
 - 1. Fire rated or treated on all sides with at least two coats of fire-retardant light-colored paint (minimum 1-hour rating).
 - 2. A/C grade or better, void free.
 - 3. Unless noted otherwise, 8 foot high, with minimum 3/4" thickness.
 - 4. Kiln dried to maximum moisture content of 15% (to prevent warping).
 - 5. Plywood shall be mounted at a minimum of 8" AFF with "A" side exposed. Mount securely to wall framing members to ensure that plywood can support attached equipment.

2.2 RACEWAYS

- A. All low voltage cabling shall be installed in raceway systems when located in concealed, non-accessible locations. In general, raceways are required for outlets in walls up to above accessible ceilings, above non-accessible ceilings, all wall penetrations etc. Provide bushings at all raceway terminations. Fire stop and fire seal all penetrations of fire rated walls.
- B. Surface Raceway:
 - 1. Surface raceway shall only be used with prior approval in remodels and modifications to existing spaces where wall and ceiling voids do not permit concealed installation. Surface raceway shall not be used at any other location unless called for on the drawings. All surface raceway and outlets must be painted to match the surface it is attached to. Use outlets and fittings by the same Manufacturer and approved for use with the raceway.
 - 2. Surface raceways shall be Wiremold #500 or #700 series, or approved equal. In all cases, do not exceed the fill per the Manufacturers published data.

2.3 CABLE SUPPORTS:

- A. Appropriate cable supports shall be used at all times to prevent unnecessary tension or slag in the cable bundles. Support spacing and size shall be as required to comply with applicable ANSI Standards and manufacturers recommendations.
- B. J-Hooks: J-Hooks shall be sized to support all cable with a maximum fill of 40%.
- C. Cable Wraps: All cable wraps shall be plenum rated re-enterable hook and loop type, sized as required.

2.4 CONDUIT SLEEVES:

- A. Conduit sleeves shall be one of the following:

1. Rigid steel or IMC conduit with threaded ends and non-metallic bushings on each end.
 2. EMT conduit with U.L. Listed slide on non-metallic bushings on each end.
- B. Fire rated conduit sleeves shall be:
1. Provided at fire rated walls or penetrations and as indicated on the drawings.
 2. 'Hilti' #CP 653, or approved equal.

2.5 CABLE LABELS:

- A. Shall meet the legibility, defacement, exposure, and adhesion requirements of UL 969. Cable labels shall be preprinted or computer printed type. Handwritten labels are not acceptable. Labels shall be flexible vinyl, laminating type resistant to moderate amounts of oil, dirt, and temperature ranges from -40°F to 158°F. Label color shall contrast with cable jacket color to make labels easily distinguishable. (Brady material B-427 or equal thermal transfer printable vinyl tape.)
- B. Labeling of cable shall consist of lettering or numbering as required by Owner to coordinate with existing labeling schemes. Contractor to coordinate exact labeling scheme of cables with Owner.

2.6 GROUNDING AND BONDING: REFER TO "GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS".

PART 3 - EXECUTION

3.1 REQUIREMENTS FOR LOW VOLTAGE SYSTEMS CABLE INSTALLATION:

- A. General: Examine areas and conditions under which low voltage cabling systems are to be installed. Notify the Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in an acceptable manner.
- B. Cable Pathways:
1. Pathways shall be designed and installed to meet applicable local and national building and electrical codes or regulations.
 2. All pathway components shall be installed according to manufacturer's specifications.
 3. Grounding/Earthing and bonding of pathways shall comply with applicable codes and regulations.
 4. Pathways shall not have exposed sharp edges that may come into contact with low voltage systems cables.
 5. The number of cables placed in a pathway shall not exceed manufacturer specifications, nor, shall the geometric shape of a cable be affected.
 6. Pathways shall not be located in elevator shafts.
 7. Vertically routed cables through chases must be supported per manufacturers and applicable ANSI Standards to prevent cable tension from occurring.

8. All cables above accessible ceilings shall be supported by cable trays and/or j-hooks located approximately 6" above lay-in ceilings below all mechanical and other electrical equipment.
9. J-Hooks: J-Hooks shall be used in common areas where cable trays are not available and/or as indicated on the plans. J-Hooks shall be located with a maximum spacing of 4'-0" on center. Cables shall not contact the ceilings, piping, light fixtures, ducts, etc. All cables must be suspended independently from other supports.
10. Cable Wraps: Cable wraps shall be used at appropriate intervals to secure cable between j-hooks or cable trays, and to provide strain relief at termination points. These wraps shall not be over tightened to the point of deforming or crimping the cable sheath. Cable wraps should rotate 360 degrees when applied correctly. Spacing shall be a maximum of 4'-0". Placement shall not be over cable labels. Cable wraps (zip-tie type or Velcro type) shall not be used as a means of support.
11. Conduit Sleeves: Conduit sleeves shall be provided where cables are indicated to pass through walls and at other locations as indicated on the plans. Sleeves shall be 2-inch conduit minimum extending 6-inches on either side of walls. Where possible, sleeves shall be located 6-inches above ceiling. See paragraph "FIRESTOPPING" for sleeves located in fire rated partitions or floors.

C. Bend Radius:

1. The maximum cable bend radii shall not exceed manufacturer's specifications.

D. Wiring Methods

1. Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
 - a. Install plenum rated cable in environmental air spaces, including plenum ceilings.
2. Bundle, lace and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.2 FIRESTOPPING:

- A. Properly installed fire stop systems shall be installed to prevent or retard the spread of fire, smoke, water, and gases through all floors, and fire/smoke walls. Fire stops shall be UL listed for the wall rating and construction method. This requirement applies to openings designed for low voltage systems cabling use that may or may not be penetrated by cables, wires, or raceways.
 1. Raceways: Completely fill and seal clearances between raceways and openings with fire stop material.
 2. Fire Rated Sleeves: Completely fill and seal clearances between sleeves and openings with fire stop material. Fire rated conduit sleeves shall comply with paragraph "CONDUIT SLEEVES".
- B. Fire stops shall be installed according to applicable codes.
- C. Documentation of fire stops shall be in accordance with the latest edition of TIA-606.

3.3 ADJUSTING AND CLEANING:

- A. Cleaning: Clean all equipment and components of dirt and construction debris upon completion of installation. Remove scrap cable components off site as required.
- B. Touch-up: Touch-up scratched or marred enclosure surfaces to match original finishes.
- C. Protection: Protect installed equipment, cabling and components from damage during remainder of construction period.

3.4 LABELING:

- A. Labeling of cable shall consist of lettering or numbering as required by Owner to coordinate with existing labeling schemes. Contractor to coordinate exact labeling scheme of cables with Owner.
- B. Documentation of labeling shall be in accordance with the latest edition of TIA-606

3.5 REMOVAL OF EXISTING CABLE:

- A. Existing low voltage systems cable that is not terminated at both ends at a connector or other equipment shall be removed unless identified for future use with a tag.

END OF SECTION

SECTION 28 31 00 - FIRE ALARM – ADDRESSABLE

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section of the specifications includes the furnishing, installation, and connection of additional solid-state, low voltage, modular, hardwire, supervised fire alarm components to an existing fire alarm system to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm indicating devices, control panels, auxiliary control devices, annunciators, power supplies, and wiring as shown on the drawings and specified. The setting of all addressable devices shall be performed by the manufacturer.
- B. Equipment and devices shall be compatible with the existing fire alarm systems.
 - 1. Wiley Elementary: Simplex #4010
 - 2. Holcomb Elementary School: Silent Knight (by Honeywell) #5820XL
- C. Fire Alarm systems shall comply with requirements of NFPA 70, 72, (including appendices) 90A, 101 for local building systems except as modified and supplemented by this specification. This is a performance specification. The devices shown on the drawings indicate design intent and shall be the minimum provided. Provide all other devices as required by other governing laws, codes, standards, and local inspectors.
- D. The Electrical Contractor shall prepare design drawings (including plans showing device locations and riser diagram), calculations, documents, and catalogs cut sheets on all components and submit as shop drawings for approval. The system designer shall be identified on the system design documents. The system designer and installer shall provide evidence of their qualifications and/or certifications when required by the AHJ or engineer of record.
 - 1. Submit with all other required submittals to the local Fire Department or authority having jurisdiction (AHJ) and obtain approval. After approval stamp is secured from the local Fire Department, the shop drawings shall be submitted to the Engineer for final approval.

1.2 CONTROL PANELS:

- A. Connect proposed devices to the existing fire alarm control panels within each building.
- B. Audio/visual signals shall only sound upon any alarm within the building served.

1.3 POST CONTRACT MAINTENANCE:

- A. Complete maintenance and inspection service for the new fire alarm system devices and components shall be provided, by a factory trained authorized representative of the manufacturer of the major equipment, for a period of two (2) years after acceptance of the installation by the engineer.

- B. Maintenance and inspection service shall be performed by factory trained authorized representatives of the major equipment manufacturer. Service availability shall be within 150 miles.
- C. Maintenance service shall include the following:
 - 1. Inspection:
 - a. Inspect all equipment per NFPA 72 prior to final acceptance by Owner and at six (6) month intervals.
 - b. Testing, cleaning, adjusting, repairing, and replacing of all components as necessary, to keep the system in reliable condition and proper working order.
 - c. Submit a company contact and proposed schedule for inspection and testing through the remainder of the two year period.
 - d. Submit a list of recurring inspection and maintenance items required following the two year period.
 - e. Furnishing all tools, test instruments, cleaning materials and parts required.
 - f. Battery and charger maintenance shall be included.
 - 2. Emergency Service:
 - a. Normal and overtime emergency call-back service shall consist of responding to calls via telephone within one (1) hour of notification of system trouble.
 - b. Overtime emergency call-back service shall be limited to minor adjustments and repairs to affect the integrity of the system.
 - c. Non-operational system situations and associated on-site service shall be provided within 24 hours of notification.
- D. Install access panels approved by the architect for all devices located in non-accessible spaces. Panels shall be flush locking type with a fire rating equal to the ceiling system.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIAL, GENERAL:

- A. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by Underwriters Laboratories, Inc., and Factory Mutual Research Corporation. The authorized representative of the manufacturer of the major equipment such as control panel, annunciator, transmitters, and initiating devices, shall install and be responsible for satisfactory total system operation and its certification. Manufacturer shall provide NICET certified personnel to test equipment.
- B. Approved Manufacturers: SimplexGrinnell, Silent Knight (by Honeywell), or compatible.

2.2 WIRING:

- A. Conduit and Wire Sections RACEWAY SYSTEMS and LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES shall apply:

1. This contractor shall furnish and install all wiring, conduit, junction boxes and outlet boxes required for the installation of a complete system. All wiring shall be installed in red colored metallic conduit; wiring shall be color coded throughout and shall test free and clear of opens, grounds and shorts between conductors. All wiring shall be #18 gauge or minimum size as determined by the manufacturer, copper, with the exception of audio and visual alarm devices which shall have #14 gauge copper. All wiring shall have a minimum insulation rating of 300V. All equipment shall be grounded with an approved earth ground wire being supplied at the control panel. All wiring shall be in conformance with Article 760 of the National Electric Code. Audible and visual devices shall be capable of being controlled individually.
2. Contractor and equipment supplier shall jointly provide a proposed riser diagram of all changes/additions for the fire alarm system indicating all devices, equipment, and wiring with the submittals prior to construction. If changes are made during construction a corrected riser diagram shall be submitted with the operating and maintenance manuals upon project completion. Riser diagram shall use symbols as shown on the drawings and shall have room numbers adjacent to all devices. All wiring shall be in conduit.
3. Wires in junction boxes and cabinets shall be permanently tagged and identified with metal or phenolic tags attached by nylon ties.

B. Terminal Boxes, Junction Boxes and Cabinets:

1. Shall be galvanized steel and in accordance with UL.
2. Paint box and cover red and identify with letters of white paint stenciled as "Fire Alarm System" in accordance with Section PAINTING.
3. Junction boxes shall have a volume 40 percent greater than required by the NEC. Minimum sized wire shall be considered as 14 AWG for calculation purposes.
4. Terminal cabinets shall have identified pressure type terminal strips, and shall be located at the base of each riser as shown on the drawings.

C. Initiating circuits shall be arranged to serve like categories (manual, smoke, waterflow). Mixed category circuitry shall not be permitted.

D. Audible indicating devices and visual indicating devices shall be capable of being controlled individually.

2.3 FIRE ALARM CONTROL PANELS (EXISTING):

A. Function:

1. Operate as a supervised, positive noninterfering successive alarm system. Each power source shall also be supervised from the other source for loss of power.
2. Supervise all signal initiating circuits, alarm indicating circuits, alarm transmitter trip circuits, and sprinkler and standpipe valves.
3. Detect the operation of any signal initiating device and the area of the alarm condition, and operate all alarm and designated auxiliary devices.
4. Visually and audible annunciate any trouble condition such as main power failure, ground or system wiring derangement, and sprinkler system and standpipe valve off-normal position.

B. Power Supply:

1. The control panel shall derive its normal power from a 120 volt, 60 Hz supply. Standby power shall be provided by a 24 volt DC battery as hereinafter specified. The normal power shall be transformed, rectified, coordinated, and interfaced with the standby battery and charger.
2. The door holder power shall be arranged so that momentary or sustained loss of main operating power shall not cause the release of any door for a minimum of 15 seconds. This may be accomplished by floating the door holders across the battery supply or by other approved means accomplishing the same function.
3. Power supply for smoke detectors shall be taken from the fire alarm control panel.
4. Provide protectors to protect the fire alarm equipment from damage due to lightning or voltage and current transients.
5. Provide additional power supplies as required.

C. Circuit Arrangement:

1. Provide means whereby any device or signal circuit may be disconnected from the system. Removing any initiation or alarm circuit shall leave the remainder of the system in normal operating condition, and light an individual trouble lamp which shall remain lighted until the circuit is restored to normal operating condition.
2. Arrange circuits so that if an open circuit occurs in the signal coil, it shall not prevent other audible signals on the same circuit from sounding.
3. Each circuit shall be individually fused.

D. Circuit Supervision:

1. Each alarm initiating circuit, alarm indicating circuit, and local energy transmitter trip circuit, and sprinkler and standpipe valve circuit shall be supervised against the occurrence of a break or ground fault condition in the field wiring. These conditions shall cause a trouble signal to sound in the control panel until manually silenced by an off switch.
2. Sprinkler system valves, standpipe control valves, PIV, and main gate valves shall also be supervised for off-normal position. Valve supervision shall indicate where the valve is located. Closing a valve shall sound a supervisory signal in the control panel until silenced by an off switch. Valve operation shall not cause an alarm signal.

E. Trouble signals:

1. Arrange the trouble circuit for ring back operation to prevent switch disarrangement during normal supervisory condition. Automatic reset arrangement is acceptable in lieu of ring back operation.
2. System trouble switch off and on lamps shall be visible through the control panel door.

2.4 BATTERY AND CHARGER:

A. Battery:

1. Shall be 24-volt nominal.
2. Wiley Elementary School: Battery shall have sufficient capacity to power the fire alarm system for not less than four hours plus five minutes of alarm to an end voltage of 1.14 volts per cell, upon a normal AC power failure. System load shall

include the power required by the electromagnetic door holders for a minimum of fifteen seconds.

2. Holcomb Elementary School: Battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus five minutes of alarm to an end voltage of 1.14 volts per cell, upon normal AC power failure. System load shall include the power required by the electromagnetic door holders for a minimum of fifteen seconds.
3. Battery racks shall be steel with an alkali-resistant finish.
4. Battery calculations shall include a 20 percent safety margin to the calculated amp hour rating.
5. Provide additional battery capacity as required.

B. Battery Charger:

1. Shall be completely automatic, with constant potential charger maintaining the battery fully charged under all service conditions. Charger shall operate from a 120-volt, 60 hertz source.
2. Shall be rated for fully charging a completely discharged battery within 48 hours while simultaneously supplying any loads connected to the battery.
3. A trouble condition shall actuate the fire alarm trouble signal.
4. Charger shall have automatic AC line voltage regulation, automatic current-limiting features, and adjustable voltage controls.

2.5 RECORD DODUMENTS:

A. System Record Documents Enclosure:

1. Provide red fire alarm System Record Documents (SRD) enclosure equal to Space Age Electronics, Inc. SRD ACE-11.
2. Mount SRD adjacent to the fire alarm control panel or other AHJ approved location.

2.6 AUDIO/VISUAL FIRE ALARM SIGNAL DEVICES:

- A. Shall be electrical supervised, flush mounted at 80" AFF per ADA. Audio devices shall use the ANSI S3.41 Three-Pulse Temporal Code Standard Evacuation Signal.
- B. Unless otherwise shown on the drawings, shall have a nominal rating of 87 dB at ten feet.
- C. Mount on removable adapter plates on conduit boxes.
- D. Provide manufacturer's surface mounted box adapter for surface mounted devices in finished spaces.
- E. Audio signals located outdoors shall be weatherproof type with metal housing and protective grille.
- F. Each signal circuit (audio or visual) shall have a minimum of twenty percent spare capacity.
- G. Visual Signal: Shall be integral with the audio signal and shall have clear dome. Lettering on housing to read "FIRE" and be visible from all viewing directions. Lettering shall be white for red appliances and red for white appliances. Dome to be high impact

non-yellowing plastic. Lamps shall be low voltage type for flashing service with a xenon flasher that meets ADA and UL 1971 requirements. Lamp circuits shall be supervised.

- H. Provide all additional devices as required to meet all codes, inspector's requirements and ADA.
- I. Strobes shall be synchronized.
- J. Strobes shall be located per NFPA 72.
- K. Strobe intensity shall be per the following:

Minimum Required Light Output, Candela (cd) (Effective Intensity) Wall Mounted Visual Signal			
Maximum Room Size	One Light Per Room (cd)	Two Lights per Room (Located On Opposite Walls) (cd)	Four Lights per Room (One Light per Wall) (cd)
20' x 20'	15	-	-
30' x 30'	34	15	-
40' x 40'	60	30	15
50' x 50'	94	60	30
60' x 60'	135	95	30
70' x 70'	184	95	60
80' x 80'	240	135	60
90' x 90'	304	185	95
100' x 100'	375	240	95

Minimum Required Output, Candela (cd) (Effective Intensity) Ceiling Mounted Visual Signal		
Maximum Room Size	Maximum Lens Height	Minimum Required Light Output, One Light
20' x 20'	10'	15
30' x 30'	10'	30
40' x 40'	10'	60
50' x 50'	10'	95
70' x 70'	10'	185
20' x 20'	20'	30
30' x 30'	20'	45
50' x 50'	20'	95
70' x 70'	20'	185
20' x 20'	30'	55
30' x 30'	30'	75
50' x 50'	30'	95
70' x 70'	30'	185

2.7 ADDRESSABLE MANUAL STATIONS:

- A. Furnish and install a double action, non-coded, manual fire alarm station, flush mounted.
- B. This station shall be connected to a remote interface monitor module as required, for addressable operation. Each module will have an engraved nameplate, acceptable to the engineer, with the same name setup in programming.

- C. To operate the station you must push the face panel and manually pull down which in turn activates the associated remote interface monitor module. The face panel locks in the down position providing a positive indication that the station has been operated. The station can be reset to the normal position by the use of a special reset key.
- D. The station shall be constructed of a die cast metal or fire retardant polycarbonate, finished in red enamel with raised white lettering. The station shall be jam-proof and shall be surface or semi-flush mountable. The station shall offer a break rod feature which shall not be necessary for station operation.

2.8 SMOKE/HEAT DETECTORS:

A. Addressable Ceiling Smoke Detectors:

1. Furnish and install as indicated a ceiling mounted photoelectric detector. This detector shall be environmentally compensated, and calibrated and adjusted for sensitivity at the manufacturer's factory to U.L. Standard 268 (Nominal 2.3% per foot smoke obscuration level). Each detector shall utilize solid state components and be equipped with a fully regulated LED light source for long life reliability and an insect screen to minimize nuisance alarms. The detector shall provide a multiple pulse coincidence circuit to minimize false alarms from transient smoke conditions. When the alarm threshold value is exceeded for the first time, the detector shall go into alarm only after at least 2 more consecutive sample pulses have exceeded the alarm threshold values. The detector shall be able to transmit obscuration information to FACP. Detector shall have environmental compensation circuits and shall maintain constant sensitivity even when maintenance required messages are produced.
2. Either the detector head itself or the detector base shall use magnetic (switchless), binary dipperswitches, or rotary decimal (hexadecimal) switches for the assignment of its individual address number when it is being field programmed. It shall also have a data communication line/alarm (flashing/steady) LED and terminals for making data communication line circuit connections. The detector/base assembly shall draw its power from the fire alarm control panel via the data communication line. The detector/base shall flash its LED, to assure communication, as it is being polled for status from the fire alarm control panel and shall report alarm or trouble status changes to it.
3. Outlet boxes for detectors shall be flush mounted. Each detector will have a label to coordinate with control panel description, acceptable to the engineer, with the same name setup in programming.
4. Smoke detectors shall not be located within 36" of any air diffuser or sprinkler head.

B. Addressable Duct Mounted Smoke Detectors:

1. Furnish and install photoelectric type, duct mounted smoke detectors at all supply and return ducts, all fire/smoke dampers, where indicated on the drawings, and where required by code. Duct mounted detectors shall operate similar to ceiling smoke detectors and are to be equipped with suitable duct housings from the manufacturer. Sampling tubes are to be sized according to the actual duct they are placed across in the facility. The detector housing shall have a local test capability and status indicator LED, and provisions for connecting a remote status indicator LED. The detector shall be able to transmit obscuration information to FACP.

2. Duct mounted smoke detectors shall be UL listed for their intended use and shall be compatible with the Fire alarm equipment installed. Sampling tubes shall extend across the entire width of the duct and be secured properly on each end.
3. Each detector and duct housing shall be self-compensating for the effects of air velocity (from 500 to 3,000 feet per minute), temperature, humidity, and atmospheric pressure. It shall not be necessary to field adjust the sensitivity to compensate for the above effects.
4. Each detector shall be a 2-wire or 4-wire, 24 VDC type duct smoke detector utilizing solid state components. Detectors providing integral relay initiation shall be 4-wire type detectors. Each detector shall be listed for U.L. Standard 268A.
5. The 24 VDC power to the duct detectors and the number of duct detectors on each 24 VDC power loop is completely dependent on the alarm current of the duct detector and the fused capacity of the supervised power loop and these requirements shall be designated and shown on the fire alarm submittal.
6. All duct mounted smoke detectors shall be installed in accordance with the standards and requirements set out in NFPA 90A, Installation of Air Conditioning and Ventilating Systems. The Installing contractor will be responsible for installing any additional duct mounted smoke detectors that are needed to meet the latest requirements of NFPA 90A.
7. Provide a remote alarm indicator for each duct smoke detector. For duct smoke detectors in supply and return ducts of mechanical equipment, locate remote alarm indicators at mechanical unit mounted at 46" AFF. For duct smoke detectors at fire/smoke dampers, locate remote alarm indicators as close as possible to duct detectors locations, flush mounted in ceiling.

C. Addressable Heat Detectors:

1. Furnish and install heat detectors flush mounted as indicated on the drawings. Detectors shall be combination rate-of-rise and fixed temperature. Each detector shall utilize solid state components and the activation of the rate-of-rise or fixed temperature alarm functions shall be capable of being reset from the fire alarm control panel.
2. Either the detector head itself or the detector base shall use magnetic (switchless), binary dipswitches, or rotary decimal (hexadecimal) switches for the assignment of its individual address number when it is being field programmed. It shall also have a data communication line/alarm (flashing/steady) LED and terminals for making data communication line circuit connections. The detector/base assembly shall draw its power from the fire alarm control panel via the data communication line. The detector/base shall flash its LED, to assure communication, as it is being polled for status from the fire alarm control panel and shall report alarm or trouble status changes to it.
3. *Outlet boxes for detectors shall be flush mounted. Each detector will have a label to coordinate with control panel description, acceptable to the Engineer, with the same name setup in programming.

2.9 AIR HANDLING UNIT SHUT DOWN RELAYS:

- A. 24 VDC operation, mounted in surface cabinet. These relays shall be controlled and powered from the fire alarm control panel and must be supervised. Contacts shall be 2P D.T. rated at 2 amps resistive 28 VDC/120VAC.

2.10 ELECTROMAGNETIC DOOR HOLDERS:

- A. Provide as part of the fire alarm system individual door holders at all locations as shown on the drawings. Any additional door holders that are specified under Section BUILDERS HARDWARE shall be connected and coordinated into the fire alarm system as specified in this section.
- B. Operation shall be by 24 volt DC supplied from the fire alarm control panel. Coordinate door holders as to voltage, ampere drain, and voltage drop with the battery, battery charger, wiring, and fire alarm system for the operation specified.
- C. A maximum of eight door holders shall be provided for each circuit with its own fuses, disconnect switch and pilot light.
- D. Associated relay control circuits shall be electrically supervised.
- E. Smoke detectors shall not be incorporated as an integral part of door holders, but are functionally associated as hereinafter specified.
- F. Provide master control switches with pilot light, for maintaining power to door holders during fire alarm tests. A switch shall be located at the fire alarm control panel.

2.11 NOTIFICATION APPLIANCE CONTROL (NAC) PANELS:

- A. Notification appliance control panels shall be provided as required by the system supplier.
- B. Units shall be UL 864 listed for power limited operation.
- C. Power supplies shall support a full 8 amps of notification power even if the battery is in a degraded mode and only AC power is connected.
- D. The unit shall incorporate a built-in battery charger with automatic switchover to battery back-up in the event of AC power failure.
- E. Horn and strobe circuits shall be synchronized.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Installation shall be in accordance with the NEC, as shown on the drawings, and as recommended by the major equipment manufacturer.
- B. Install smoke detector heads not more than two weeks prior to final inspection. Test the detectors in place. Cleaning detectors at the time of final inspection is the contractor's responsibility.
- C. Field verify location of area smoke detectors and heat detectors. Do not locate within 36-inches of a HVAC diffuser (supply or return), in a direct air flow, within 36-inches of a sprinkler head, or within 36-inches of the tip of a ceiling fan blade. Smoke detectors for door release shall be located on the centerline of the door and a maximum of 5 feet from the door. The minimum distance from the door is the depth of the wall section above the

door, but not less than 12". Provide smoke detectors at all fire alarm control equipment (fire alarm control panels, NAC panels, etc.)

- D. Duct smoke detectors should be located in the area between 6 and 10 duct equivalent diameters of straight, uninterrupted run. Duct smoke detectors for fire/smoke dampers should be located between the last inlet or outlet upstream of the damper and the first inlet or outlet downstream of the damper. Coordinate location of duct detectors with humidifier dispersion grids as required.
- E. Fan shutdown relay wiring shall be located within 3 feet of the fan controls and the wiring to the relay shall be monitored.
- F. All fire alarm control equipment (fire alarm control panels, NAC panels, etc.) shall be connected to emergency power if the building or structure has an emergency power distribution system.

3.2 TYPICAL OPERATION:

- A. Normal System Operation: Actuation of any manual station, smoke detector, or water flow switch shall cause the following operations to occur, unless otherwise specified:
 - 1. Operate the audible/visual signals in the building. Audible devices shall be temporal coded.
 - 2. Transmit a separate alarm/trouble signal, via phone line to a central monitoring agency.
 - 3. Duct type smoke detectors and waterflow switches shall, in addition to the above, perform the functions specified in the mechanical specifications or shown on the mechanical drawings.
 - 4. Operation of any sprinkler and standpipe valve supervisory switch shall cause the system to go into trouble condition.
 - a. It shall not cause the system to go into alarm condition.
 - b. It shall not prevent any flow switch from actuating an alarm.
 - 5. Provide duct detectors in both the supply and return air ducts for air handling equipment, fan coil units; and make-up air unit, 2000 CFM or larger. Provide fan shut down relays to shut down AHU's, make-up air units, relief fans, exhaust fans and fan coil units.
- B. System Supervision: System supervision shall include the following conditions:
 - 1. Loss of operating or standby power.
 - 2. A signal ground or open circuit in alarm initiating circuits, alarm indicating circuits, and auxiliary transmitter trip circuits, and sprinkler and standpipe valve circuits. Each circuit shall have its own supervisory devices.
 - 3. Off-normal position of sprinkler and standpipe valves.
 - 4. Battery and battery charger shall have supervision as specified elsewhere in this section.
- C. Trouble Signals:

1. Derangement of any of the above supervised conditions shall be visually and audible annunciated at the fire alarm control panel. Each circuit shall have individual visual annunciation.
2. Operation of the sprinkler and standpipe valves towards the closed position shall cause a supervisory signal.
3. Trouble signals shall be retransmitted, via an individual auxiliariized transmitter, to remote locations.

3.3 TESTS:

- A. Provide the service of a competent, NICET certified, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. Make all adjustments and tests in the presence of the engineer.
- B. When the systems have been completed and prior to the scheduling of the final inspection, furnish testing equipment and perform the following tests for installed components. When any defects are detected, make repairs or install replacement components, and repeat the tests until such time that the complete fire alarm system meets all contract requirements. After the system has passed the test and been approved by the engineer, the contractor may request a final inspection. Final acceptance of system will not be made until retested at final inspection.
 1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
 2. Test the insulation on all installed cable and wiring by standard methods as recommended by the equipment manufacturer.
 3. Open fire alarm station circuits to see if trouble signal actuates.
 4. Open audible signal circuits to see if the trouble signal actuates.
 5. Ground fire alarm station circuits and verify response of trouble signals.
 6. Ground audible signal circuits and verify response of trouble signals.
 7. Check transmission of all fire alarm devices.
 8. Check installation, supervision, operation and sensitivity of smoke detectors to ascertain that they will avoid false alarm signals and will function as specified. See Article 2.8, SMOKE DETECTORS.
 9. Upon completion of Fire Alarm System Testing, submit to engineer one (1) copy of Testing and Inspection Report signed off as 100 percent functioning by the System Supplier and the Electrical contractor. Bind one (1) additional copy in each of the operation and maintenance manuals. A record of completion document, as described in NFPA 72, shall be stored at the fire alarm control panel or other approved location by the AHJ. When not stored at the fire alarm control panel the location of this document shall be identified at the fire alarm control panel. If documents are stored in a separate enclosure or cabinet it shall be prominently labeled "Fire Alarm Documents". Other documents required to be located at the fire alarm control panel include:
 - a. Owner's manual and manufacturers published instructions covering all system equipment.
 - b. Record drawings.
 - c. For software based systems, record copy of the site specific software.
 - d. Written sequence of operation.

3.4 FINAL INSPECTION:

- A. At the final inspection a factory trained representative of the manufacturer of the major equipment shall perform the tests in Article 3.3 TESTS. In addition the representative shall demonstrate that the systems function properly in every respect. The demonstration shall be made in the presence of the Owners Representative.

3.5 INSTRUCTION:

- A. Furnish the services of a competent instructor for not less than two four-hour periods for instructing personnel in the operation and maintenance of the system, on the dates requested by the Engineer.

END OF SECTION

- E. Vegetation Removed: Do not burn, bury, landfill, or leave on site, except as indicated.
 - 1. Chip, grind, crush, or shred vegetation for mulching, composting, or other purposes; preference should be given to on-site uses.
 - 2. Trees: Sell if marketable; if not, treat as specified for other vegetation removed; remove stumps and roots to depth of 18 inches.
 - 3. Existing Stumps: Treat as specified for other vegetation removed; remove stumps and roots to depth of 24 inches.
- F. Dead Wood: Remove all dead trees (standing or down), limbs, and dry brush on entire site; treat as specified for vegetation removed.
- G. Restoration: If vegetation outside removal limits or within specified protective fences is damaged or destroyed due to subsequent construction operations, replace at no cost to Owner.

3.04 DEBRIS

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for concrete slabs-on-grade.
4. Subbase course for concrete walks, pavements.
5. Excavating and backfilling for utility trenches.

1.2 DEFINITIONS

A. Backfill: Soil material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

- I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.3 QUALITY ASSURANCE

- A. Preexcavation Conference: Conduct conference at Project site.

1.4 PROJECT CONDITIONS

- A. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth moving operations.
- B. Do not commence earth moving operations until existing vegetation has been removed.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification Groups CL, GW, GP, GM, GC, SW, SP, and SM according to ASTM D 2487 or a combination of these groups, free of rock or gravel larger than 3 inches in any dimensions, debris, waste, frozen material, vegetation, and other deleterious matter with the following properties:
 - 1. Plasticity Index: Less than 46
 - 2. Plasticity Index: Less than 25
 - 3. All soils must be approved by the Geotechnical Engineer.
- C. Unsatisfactory Soils: Soil Classification Groups ML, OL, CH, MH, OH, and PT according to ASTM D 2487, Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7 according to AASHTO M 145, or a combination of these groups.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
 - 2. Soils with a liquid limit of 46 or greater.
- D. Low Volume Change Soils: Approved soils free of debris, waste, frozen material, vegetation, and other deleterious matter.
 - 1. Liquid Limit: Less than 40
 - 2. Plasticity Limit: At least 5, but less than 15

3. Chemically Treated Soils: Cohesive soils modified with hydrated lime of Class C fly ash as direct by the Geotechnical Engineer to achieve properties equal to those defined by LVC soils.
- E. Granular Aggregate Base LVC Soils: Approved soils free of debris, waste, frozen materials, vegetation, and other deleterious matter.
 1. Silty gravel meeting AB-3 of the KDOT specifications
 2. Crushed Concrete screenings: with a gradation equal to material meeting Ab-3 or the KDOT specifications.
 - F. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.
 - G. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.
 - H. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.
 - I. Drainage Course: Narrowly graded mixture of washed, crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

2.2 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored to comply with local practice or requirements of authorities having jurisdiction.
- B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored to comply with local practice or requirements of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth moving operations.

- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.3 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus **1 inch (25 mm)**. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 - 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
- B. Excavations at Edges of Tree- and Plant-Protection Zones:
 - 1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
 - 2. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.4 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.5 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit unless otherwise indicated.
 - 1. Clearance: 12 inches each side of pipe or conduit
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of

pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material, 4 inches (100 mm) deeper elsewhere, to allow for bedding course.

D. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
3. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.6 SUBGRADE INSPECTION

- A. Remove all vegetation, organic top soil material, debris, existing fill soils, and other deleterious matter from the surface within at least 10 ft. beyond all future building and paving areas.
- B. Cut site as required to provide 18 inch thick zone of LVC material below the 4 inch thick layer of granular leveling bed material below the floor slab with and at least 5 feet beyond the building additions.
- C. Do not cut below the bottom of the existing footing elevations for a lateral distance of 3 feet from the face of the existing building foundation system when removing any existing fill soils or when cutting site for LVC zone. If it is a necessity begin a slope cut at a lateral distance of 3 feet from the face of the existing building footing to the required cut elevation with 1 to 1 vertical to horizontal slope. Use care and caution to not undermine the soils below the existing foundation systems. (Typical bottom of existing footings at elevations 95-6 +/- where existing grade is near finished floor elevations. Contractor to field verify bottom of existing footing elevations.
- D. Proof roll the exposed subgrade soils, in the presence of the soils engineer, using a rubber tired vehicle weighing at least 20 tons to locate soft unstable soils.
- E. Scarify, plow or otherwise loosen the top 8 inch of the exposed subgrade following the proof-rolling operations and the removal of any identified zones of soft or unstable soils. Pulverize and properly moisture condition the scarified soils prior to compacting.
- F. The specified moisture content of the subgrade soils must be maintained during construction. The moisture content of the subgrade soils shall be evaluated prior to the installation of the granular sub-base below the floor slab.

3.7 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean

concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.8 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.9 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Trenches under Footings: Backfill trenches excavated under footings and within [18 inches (450 mm)] of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in "Cast-in-Place Concrete"
- D. Trenches under Roadways: Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of inches of concrete before backfilling or placing roadway subbase course. Concrete is specified in "Cast-in-Place Concrete"
- E. Place and compact initial backfill of [subbase material] [satisfactory soil], free of particles larger than [1 inch (25 mm)] <Insert dimension> in any dimension, to a height of 12 inches (300 mm) over the pipe or conduit.
 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- F. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- G. Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.10 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:

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1. Under building areas and at least 10 ft. beyond place satisfactory general fill soils or low volume change (LVC) soils to elevation 97.83. Place only low volume change soils above elevation 97.83 to elevation 98.83 Place granular aggregate base LVC soils from elevation 98.83 to 99.33. Place +/- 4" thick layer of clean granular drainage course material above the granular aggregate base LVC material and directly below the slab on grade floor areas.
2. Under walks and pavement areas as shown on civil plans.
3. All areas outside of the future building areas, walks or pavement areas, place satisfactory general fill soils.

3.11 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.12 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 9 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
 1. Under building areas, walks, and pavements, scarify and recompact top 6 inches of existing sub-grade and each layer of backfill of fill soil material to at least 95 percent, but no more than 100 percent
 2. Outside of all building areas, walks and pavements, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soils to at least 95 percent.

3.13 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.

3.14 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course[and base course] under pavements and walks as follows:
 1. Shape subbase course and base course to required crown elevations and cross-slope grades.
 2. Place subbase course and base course] that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 3. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698

3.15 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
 1. Place drainage course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
 2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.16 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

- D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.17 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

SECTION 31 31 16 - TERMITE CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Chemical soil treatment.

1.02 REFERENCE STANDARDS

- A. Title 7, United States Code, 136 through 136y - Federal Insecticide, Fungicide and Rodenticide Act; 1947 (Revised 2001).

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate toxicants to be used, composition by percentage, dilution schedule, intended application rate.
- C. Manufacturer's Application Instructions: Indicate caution requirements and ____.
- D. Manufacturer's Certificate: Certify that toxicants meet or exceed specified requirements.
- E. Certificate of compliance from authority having jurisdiction indicating approval of toxicants.
- F. Record moisture content of soil before application.
- G. Warranty: Submit warranty and ensure that forms have been completed in Owner's name.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing this type of work and:
 - 1. Having minimum of 2 years documented experience.
 - 2. Approved by manufacturer of treatment materials.
 - 3. Licensed in the State in which the Project is located.

1.05 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five years from date of Substantial Completion installer's warranty against damage to building caused by termites.
 - 1. Include coverage for repairs to building and to contents damaged due to building damage. Repair damage and, if required, re-treat.
 - 2. Inspect annually and report in writing to Owner. Provide inspection service for Five years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Manufacturers:
 - 1. Bayer Environmental Science Corp: www.backedbybayer.com/pest-management.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Toxicant Chemical: EPA approved; synthetically color dyed to permit visual identification of treated soil.
- C. Diluent: Recommended by toxicant manufacturer.

2.02 MIXES

- A. Mix toxicant to manufacturer's instructions.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that soil surfaces are unfrozen, sufficiently dry to absorb toxicant, and ready to receive treatment.
- B. Verify final grading is complete.

3.02 APPLICATION

- A. Comply with requirements of U.S. EPA and applicable state and local codes.
- B. Spray apply toxicant in accordance with manufacturer's instructions.
- C. Apply toxicant at following locations:
 - 1. Under Slabs-on-Grade.
 - 2. At Both Sides of Foundation Surface.
 - 3. Soil Within 10 feet of Building Perimeter For a Depth of 5 feet.
- D. Under slabs, apply toxicant immediately prior to installation of vapor barrier.
- E. At foundation walls, apply toxicant immediately prior to finish grading work outside foundations.
- F. Apply extra treatment to structure penetration surfaces such as pipe or ducts, and soil penetrations such as grounding rods or posts.
- G. Re-treat disturbed treated soil with same toxicant as original treatment.
- H. If inspection or testing identifies the presence of termites, re-treat soil and re-test.

3.03 PROTECTION

- A. Do not permit soil grading over treated work.

END OF SECTION

SECTION 32 13 13 - CONCRETE PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete sidewalks, stair steps, integral curbs, gutters, and parking areas.

1.02 RELATED REQUIREMENTS

- A. Section 03 10 00 - Concrete Forming and Accessories.
- B. Section 03 20 00 - Concrete Reinforcing.
- C. Section 03 30 00 - Cast-in-Place Concrete.
- D. Section 07 92 00 - Joint Sealants: Sealing joints.
- E. Section 09 91 13 - Exterior Painting: Pavement markings.
- F. Section 31 22 00 - Grading: Preparation of site for paving and base and preparation of subsoil at pavement perimeter for planting.
- G. Section 31 23 23 - Fill: Compacted subbase for paving.
- H. Section 32 12 16 - Asphalt Paving: Asphalt wearing course.
- I. Section 32 17 26 - Tactile Warning Surfacing: Plastic tactile and detectable warning tiles for pedestrian walking surfaces.

1.03 REFERENCE STANDARDS

- A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).
- B. ACI 301 - Specifications for Structural Concrete; 2010 (Errata 2012).
- C. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000.
- D. ACI 305R - Hot Weather Concreting; 2010.
- E. ACI 306R - Cold Weather Concreting; 2010.
- F. ASTM A185/A185M - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete; 2007.
- G. ASTM A497/A497M - Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete; 2007.
- H. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.
- I. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2015.
- J. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2013.
- K. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2015a.
- L. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2015.
- M. ASTM C150/C150M - Standard Specification for Portland Cement; 2015.

- N. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2014.
- O. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a.
- P. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2011.
- Q. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2013.
- R. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2015.
- S. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2014.
- T. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2004 (Reapproved 2013).
- U. ASTM D1752 - Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction; 2004a (Reapproved 2013).

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on joint filler, admixtures, and curing compound.
- C. Design Data: Indicate pavement thickness, designed concrete strength, reinforcement, and typical details.

PART 2 PRODUCTS

2.01 PAVING ASSEMBLIES

- A. Comply with applicable requirements of ACI 301.
- B. Design paving for parking and residential streets.
- C. Concrete Sidewalks: 3,000 psi 28 day concrete, 4 inches thick, buff color Portland cement, exposed aggregate finish.
- D. Parking Area Pavement: 4,000 psi 28 day concrete, 6 inches thick, 6x6 - W2.9 x W2.9 mesh reinforcement, wood float finish.

2.02 FORM MATERIALS

- A. Form Materials: Conform to ACI 301.
- B. Joint Filler: Preformed; non-extruding bituminous type (ASTM D1751) or sponge rubber or cork (ASTM D1752).
 - 1. Thickness: 1/2 inch.

2.03 REINFORCEMENT

- A. Reinforcing Steel and Welded Wire Reinforcement: Types specified in Section 03 20 00.

2.04 CONCRETE MATERIALS

- A. Obtain cementitious materials from same source throughout.
- B. Concrete Materials: As specified in Section 03 30 00.

2.05 ACCESSORIES

- A. Curing Compound: ASTM C309, Type 1, Class A.

2.06 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
- B. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.
- C. Concrete Properties:
 - 1. Compressive strength, when tested in accordance with ASTM C39/C39M at 28 days; 4000 psi.

2.07 MIXING

- A. Transit Mixers: Comply with ASTM C94/C94M.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

3.02 SUBBASE

- A. See Section 32 11 23 for construction of base course for work of this Section.

3.03 PREPARATION

- A. Moisten base to minimize absorption of water from fresh concrete.
- B. Notify Architect minimum 24 hours prior to commencement of concreting operations.

3.04 FORMING

- A. Place and secure forms to correct location, dimension, profile, and gradient.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.05 REINFORCEMENT

- A. Place reinforcement at midheight of slabs-on-grade.
- B. Interrupt reinforcement at contraction joints.
- C. Place dowels to achieve pavement and curb alignment as detailed.

3.06 COLD AND HOT WEATHER CONCRETING

- A. Follow recommendations of ACI 305R when concreting during hot weather.
- B. Follow recommendations of ACI 306R when concreting during cold weather.
- C. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

3.07 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304R.
- B. Do not place concrete when base surface is wet.
- C. Ensure reinforcement, inserts, embedded parts, formed joints and ____ are not disturbed during concrete placement.
- D. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.
- E. Apply surface retarder to all exposed surfaces in accordance with manufacturer's instructions.

3.08 JOINTS

- A. Align curb, gutter, and sidewalk joints.
- B. Place 1/2 inch wide expansion joints at 80 foot intervals (maximum) and to separate paving from vertical surfaces and other components and in pattern indicated.
 - 1. Form joints with joint filler extending from bottom of pavement to within 1/2 inch of finished surface.
 - 2. Secure to resist movement by wet concrete.
- C. Provide scored joints.
 - 1. At 5 feet intervals unless otherwise shown on drawings.
 - 2. Between sidewalks and curbs.
 - 3. Between curbs and pavement.
- D. Provide keyed joints as indicated.
- E. Saw cut contraction joints 3/16 inch wide at an optimum time after finishing. Cut 1/3 into depth of slab.

3.09 FINISHING

- A. Area Paving: Light broom, texture perpendicular to pavement direction.
- B. Sidewalk Paving: Light broom, texture perpendicular to direction of travel with troweled and radiused edge 1/4 inch radius.
- C. Curbs and Gutters: Light broom, texture parallel to pavement direction.
- D. Inclined Vehicular Ramps: Broomed perpendicular to slope.
- E. Place curing compound on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.

3.10 TOLERANCES

- A. Maximum Variation of Surface Flatness: 1/4 inch in 10 ft.

B. Maximum Variation From True Position: 1/4 inch.

3.11 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
 - 1. Provide free access to concrete operations at project site and cooperate with appointed firm.
 - 2. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
 - 3. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.
- B. Compressive Strength Tests: ASTM C39/C39M; for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cu yd or less of each class of concrete placed.
 - 1. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
 - 2. Perform one slump test for each set of test cylinders taken.
- C. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.12 PROTECTION

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. Do not permit pedestrian traffic over pavement for 7 days minimum after finishing.

END OF SECTION