

# Project Manual

## Medical School Building EM and NMR Renovation

Issue for Construction

06/28/2017

PWP Project No. 216-166

### OWNER

UT-Health  
6431 Fannin Street  
Houston, TX 77030  
(713) 500-3915

### ARCHITECT

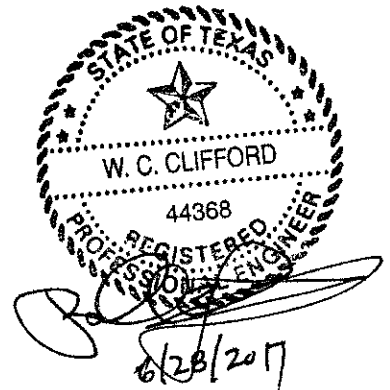
Philo Wilke Partnership  
11275 S. Sam Houston Parkway W.  
Suite 200  
Houston, Texas 77031  
(832) 554-1130

### MEP ENGINEER

E&C Engineers & Consultants Inc.  
1010 Lamar, Suite 650  
Houston, Texas 77002  
(713) 580-8800



6/28/2017



## **TABLE OF CONTENTS**

### **DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS**

00 01 10 TABLE OF CONTENTS

### **DIVISION 01 - GENERAL REQUIREMENTS**

01 10 00 SUMMARY  
01 20 00 PRICE AND PAYMENT PROCEDURES  
01 30 00 ADMINISTRATIVE REQUIREMENTS  
01 30 10 INTERNET-BASED COLLABORATION SYSTEM  
01 35 53 SECURITY PROCEDURES  
01 40 00 QUALITY REQUIREMENTS  
01 42 16 DEFINITIONS  
01 60 00 PRODUCT REQUIREMENTS  
01 61 16 VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS  
01 70 00 EXECUTION AND CLOSEOUT REQUIREMENTS  
01 78 00 CLOSEOUT SUBMITTALS

### **DIVISION 02 - EXISTING CONDITIONS**

02 41 00 DEMOLITION

### **DIVISION 03 - CONCRETE**

03 54 00 CAST UNDERLAYMENT

### **DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES**

06 41 00 ARCHITECTURAL WOOD CASEWORK

### **DIVISION 07 - THERMAL AND MOISTURE PROTECTION**

07 84 00 FIRESTOPPING  
07 92 00 JOINT SEALANTS

### **DIVISION 08 - OPENINGS**

08 12 13 HOLLOW METAL FRAMES  
08 14 16 FLUSH WOOD DOORS  
08 71 00 DOOR HARDWARE  
08 80 00 GLAZING

### **DIVISION 09 - FINISHES**

09 21 16 GYPSUM BOARD ASSEMBLIES  
09 51 00 ACOUSTICAL CEILINGS  
09 65 00 RESILIENT FLOORING  
09 67 00 FLUID-APPLIED FLOORING  
09 91 23 INTERIOR PAINTING

### **DIVISION 12 - FURNISHINGS**

12 35 53.13 METAL LABORATORY CASEWORK  
12 36 00 COUNTERTOPS

#### **DIVISION 21 – FIRE PROTECTION**

21 12 00 FIRE PROTECTION SYSTEMS  
21 13 13 WET-PIPE FIRE SPRINKLER SYSTEM

#### **DIVISION 22 – PLUMBING**

22 13 16 PLUMBING PIPING  
22 15 13 COMPRESSED AIR SYSTEM

#### **DIVISION 23 – MECHANICAL**

23 00 00 BASIC MECHANICAL REQUIREMENTS  
23 05 13 MOTORS  
23 05 29 SLEEVES, FLASHINGS, SUPPORTS AND ANCHORS  
23 05 48 VIBRATION ISOLATION  
23 05 53 MECHANICAL IDENTIFICATION  
23 05 93 TESTING, ADJUSTING AND BALANCING  
23 05 93.A TESTING, ADJUSTING AND BALANCING – CONTRACTOR RESPONSIBILITY  
23 06 20.13 HYDRONIC SPECIALTIES  
23 07 13 DUCTWORK INSULATION  
23 07 16 EQUIPMENT INSULATION  
23 07 19 PIPING INSULATION  
23 09 23 DIRECT DIGITAL CONTROL SYSTEM  
23 20 00 HVAC PUMPS  
23 20 00.A PIPING, VALVES AND FITTINGS  
23 21 00 HYDRONIC PIPING  
23 31 00 DUCTWORK  
23 33 00 DUCTWORK ACCESSORIES  
23 36 00 AIR TERMINAL UNITS (VAV)

#### **DIVISION 26 – ELECTRICAL**

26 00 00 BASIC ELECTRICAL REQUIREMENTS  
26 00 00.01 ELECTRICAL DEMOLITION  
26 05 01 BASIC ELECTRICAL MATERIALS AND METHODS  
26 05 19 CABLE, WIRE AND CONNECTORS, 600 VOLT  
26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS  
26 05 29 SECURING AND SUPPORTING DEVICES  
26 05 33 RACEWAYS, CONDUITS AND BOXES  
26 05 53 ELECTRICAL IDENTIFICATION  
26 24 16 PANELBOARDS  
26 27 26 WIRING DEVICES  
26 28 13 FUSES, 600 VOLTS  
26 28 16 DISCONNECT SWITCHES  
26 51 00 INTERIOR LIGHTING

#### **DIVISION 28 – FIRE ALARM**

28 31 00 FIRE ALARM AND SMOKE DETECTION

## SECTION 01 10 00

### SUMMARY

#### PART 1 GENERAL

##### 1.01 PROJECT

- A. Project Name: UT Health Medical School Building Electron Microscope Renovation.
- B. Owner's Name: UT Health.
- C. Architect's Name: PhiloWilke Partnership.
- D. The Project consists of the alteration of existing research imaging space to accommodate two new electron microscopes..

##### 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 shown on drawings.
- B. Scope of alterations work is shown on drawings.

##### 1.04 WORK BY OWNER

- A. Items noted NIC (Not in Contract) will be supplied and installed by Owner before Substantial Completion. Some items include:
  - 1. Movable cabinets.
  - 2. Furnishings.
  - 3. Small equipment.
  - 4. Artwork.
- B. Owner will supply the following for installation by Contractor:
  - 1. Equipment indicated on the Equipment Schedule to be Owner-Furnished and Contractor Installed (OFCl).

##### 1.05 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 upon Substantial Completion.
- C. Owner intends to occupy a certain portion of the Project prior to the completion date for installation of research equipment.
- D. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- E. Schedule the Work to accommodate Owner occupancy.

##### 1.06 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.
  - 3. Work by Owner.
  - 4. Use of site and premises by the public.
- C. 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.
- D. Existing building spaces may not be used for storage.
- E. Limit shutdown of utility services to agreed hours at a time, arranged at least 24 hours in advance with Owner.
  - 1. Prevent accidental disruption of utility services to other facilities.

**1.07 WORK SEQUENCE**

A. Coordinate construction schedule and operations with Owner.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

**SECTION 01 20 00**  
**PRICE AND PAYMENT PROCEDURES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Procedures for preparation and submittal of applications for progress payments.
- B. Documentation of changes in Contract Sum and Contract Time.
- C. Change procedures.
- D. Correlation of Contractor submittals based on changes.
- E. Procedures for preparation and submittal of application for final payment.

**1.02 SCHEDULE OF VALUES**

- A. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.
- B. Forms filled out by hand will not be accepted.
- C. Submit a printed schedule on AIA Form G703 - Application and Certificate for Payment Continuation Sheet. Contractor's standard form or electronic media printout will be considered.
- D. Submit Schedule of Values in duplicate within 15 days after date of Owner-Contractor Agreement.
- E. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification Section. Identify site mobilization and bonds and insurance.
- F. Revise schedule to list approved Change Orders, with each Application For Payment.

**1.03 APPLICATIONS FOR PROGRESS PAYMENTS**

- A. Payment Period: Submit at intervals stipulated in the Agreement.
- B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
- C. Forms filled out by hand will not be accepted.
- D. Present required information in typewritten form.
- E. Form: AIA G702 Application and Certificate for Payment and AIA G703 - Continuation Sheet including continuation sheets when required.
- F. For each item, provide a column for listing each of the following:
  - 1. Item Number.
  - 2. Description of work.
  - 3. Scheduled Values.
  - 4. Previous Applications.
  - 5. Work in Place and Stored Materials under this Application.
  - 6. Authorized Change Orders.
  - 7. Total Completed and Stored to Date of Application.
  - 8. Percentage of Completion.
  - 9. Balance to Finish.
  - 10. Retainage.
- G. Execute certification by signature of authorized officer.
- H. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored Products.
- I. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of Work.
- J. Submit five (5) copies of each Application for Payment.
- K. Include the following with the application:

1. Transmittal letter as specified for Submittals in Section 01 30 00.
  2. Current construction photographs specified in Section 01 30 00.
  3. Partial release of liens from all Subcontractors for work performed in the previous month.
  4. Maintenance and Operations manuals and other pertinent information for equipment and systems prior to installation and payment request for equipment.
  5. Affidavits attesting to off-site stored products.
- L. When Architect requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

#### **1.04 MODIFICATION PROCEDURES**

- A. Submit name of the individual authorized to receive change documents and who will be responsible for informing others in Contractor's employ or subcontractors of changes to the Contract Documents.
- B. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.
- C. Architect's Supplemental Instructions (ASI): Architect will advise of minor changes in the Work not involving an adjustment to Contract Sum or Contract Time as authorized by the Conditions of the Contract by issuing supplemental instructions on AIA Form G710, or a similar form.
- D. Proposal Request (PR): Architect may issue a document, signed by the Owner, instructing Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
  1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
  2. Promptly execute the change.
- E. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within ten (10) days.
- F. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the Work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation and a statement describing the effect on Work by separate or other contractors. Document any requested substitutions in accordance with Section 01 60 00.
- G. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
  1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
  2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Architect.
  3. For change ordered by Architect without a quotation from Contractor, the amount will be determined by Architect based on the Contractor's substantiation of costs as specified for Time and Material work.
- H. Substantiation of Costs: Provide full information required for evaluation.
  1. On request, provide the following data:
    - a. Quantities of products, labor, and equipment.
    - b. Taxes, insurance, and bonds.
    - c. Overhead and profit.
    - d. Justification for any change in Contract Time.
    - e. Credit for deletions from Contract, similarly documented.
  2. Support each claim for additional costs with additional information:
    - a. Origin and date of claim.
    - b. Dates and times work was performed, and by whom.

- c. Time records and wage rates paid.
- d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
- 3. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.
  - I. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.
  - J. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.
  - K. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
  - L. Promptly enter changes in Project Record Documents.

**1.05 APPLICATION FOR FINAL PAYMENT**

- A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- B. Application for Final Payment will not be considered until the following have been accomplished:
  - 1. All closeout procedures specified in Section 01 70 00.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**



**SECTION 01 30 00**  
**ADMINISTRATIVE REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Electronic document submittal requirements.
- B. Preconstruction meeting.
- C. Progress meetings.
- D. Construction progress schedule.
- E. Submittals for review, information, and project closeout.
- F. Submittal procedures.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 30 10 - Internet-Based Collaboration System: Requirements for documentation required in this section to be stored on a Project Website.
- B. Section 01 70 00 - Execution and Closeout Requirements: Additional coordination requirements.
- C. Section 01 78 00 - Closeout Submittals: Project record documents.

**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. Selected 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](http://www.adobe.com), or Bluebeam PDF Revu, [www.bluebeam.com](http://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.
- B. Cost: The cost of the service will be paid by Owner.
- C. Submittal Service: The selected service is:
  - 1. Electronic document submittals will be processed utilizing the Internet-based collaboration system employed for the project. See section 01 30 10 - Internet-Based Collaboration System for additional requirements.
- D. Training: One, one-hour, web-based training session will be arranged for all participants, with representatives of Architect and Contractor participating; further training is the responsibility of the user of the service.

- E. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.

### **3.02 PRECONSTRUCTION MEETING**

- A. Owner will schedule a meeting after Notice of Award.
- B. Attendance Required:
  - 1. Owner.
  - 2. Architect.
  - 3. Contractor.
  - 4. Contractor's superintendent.
  - 5. All 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.
  - 8. Critical work sequencing.
  - 9. Use of premises/temporary facilities.
  - 10. Equipment deliveries and priorities.
  - 11. Coordination with Owner supplied equipment / suppliers.
  - 12. Safety procedures and first aid.
  - 13. Security.
  - 14. Housekeeping and waste disposal.
  - 15. Provisions for temporary egress, dust protection, and infection control.
  - 16. Procedures for testing.
  - 17. Procedures for maintaining record documents.
  - 18. Progress meeting schedule.
- 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. 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 outstanding Requests for Information.
  - 6. Review of submittals schedule and status of submittals.
  - 7. Maintenance of progress schedule.
  - 8. Corrective measures to regain projected schedules.

9. Planned progress during succeeding work period.
  10. Maintenance of quality and work standards.
  11. Effect of proposed changes on progress schedule and coordination.
  12. 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.
1. Distribution may be made via posting to the Internet-based collaboration system employed for the Project.

### **3.04 CONSTRUCTION PROGRESS SCHEDULE**

- A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of Work, with a general outline for remainder of Work.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. 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.
- D. Within 10 days after joint review, submit complete schedule.
- E. Submit updated schedule with each Application for Payment.

### **3.05 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.

### **3.06 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.

### **3.07 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.

### **3.08 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. Documents for Project Closeout: Make one reproduction of submittal originally reviewed. Submit one extra of submittals for information.
- C. 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.

### **3.09 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. Transmit each submittal with approved form.
- D. Identify the submittal with an identification number comprised of:
  1. The specification section number pertaining to the submittal.
  2. A sequential number, beginning at the number 1 for each specification section.
  3. If the submittal is a resubmission, a sequential alphabetic suffix, beginning with the letter 'A' for the first resubmission, 'B' for the second, and so-on.
- E. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.
- F. 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.
- G. Schedule submittals to expedite the Project, and coordinate submission of related items.
- H. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
- I. Identify deviations from Contract Documents and provide information describing the deviations and their impact upon the Work.
- J. Provide space for Contractor and Architect review stamps.
- K. When revised for resubmission, identify all changes made since previous submission.
- L. Distribute reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.
- M. Submittals not requested will not be recognized or processed.

**END OF SECTION**

**SECTION 01 30 10**  
**INTERNET-BASED COLLABORATION SYSTEM**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Requirements for use of an Internet-based (World Wide Web) system to improve communication between project team members, and consolidate documentation of project construction correspondence/documentation such as meeting reports, submittal log, information requests, change proposals, specifications, test reports, construction progress photographs and other, similar information.
- B. Requirement for computer system in temporary construction offices located at the Project site.

**1.02 RELATED SECTIONS**

- A. Section 01 30 00 - Administrative Requirements: Documentation requirements for reports that will be stored on Project Website.

**1.03 DEFINITIONS**

- A. Applications Service Provider (ASP): A company that provides Internet-based applications to clients and hosts those applications on its server computers that are accessible from the Internet.
- B. Project Web Site: A suite of web-based software applications that are accessible using only a web browser from remote locations and are used to manage and enhance communication of a project team.
- C. POTS: Plain Old Telephone Service. An acronym for a standard tip-and-ring telephone line for voice/data/fax service.
- D. kbps: Kilobits per second. Roughly 1024 data bits per second. A measure of transmission speeds.

**1.04 SYSTEM DESCRIPTION**

- A. The Owner will employ an Internet-based software system that will provide password-protected access to a centralized computer document repository and application software such as group-calendars, task lists, contact database, and discussion forums. In general, the software will run on a server that is maintained by the Owner, Architect, or 3rd party Applications Service Provider (ASP).
  - 1. The Contractor shall be required to use a Project Web Site to store electronic versions of all project-related correspondence and publications and maintain logs for project-related activities, including:
    - a. Project Schedules.
    - b. Submittals.
    - c. Request for Information (RFI).
    - d. Proposal Requests.
    - e. Applications for Payment.
    - f. Other data as may be required by the Owner.
    - g. Meeting reports.
    - h. Project progress photographs.
    - i. Project budget and schedule related items.
  - 2. Licensed access to the Project Web Site will be provided at no cost to the Contractor.

**1.05 COMPUTER SYSTEMS**

- A. The Contractor shall provide the following minimum computer system hardware/software in its field offices for the purpose of using the Project Web Site during the duration of the project:
  - 1. Computer Systems: Windows 10 or MacOS, capable of adequately running current versions of Microsoft Edge, Safari, Mozilla Firefox, or Google Chrome.

2. Page viewing/PDF creation software: Adobe Acrobat (current version) or other software with similar capability to create and mark up documents in Portable Document Format (.PDF).
3. Digital camera: Five megapixel or higher resolution.
4. Color printer: 600 x 600 dpi or higher resolution.

#### **1.06 INTERNET CONNECTIVITY**

- A. The Contractor shall provide a dedicated connection to the Internet in its field office.
  1. Where broadband Internet service is available, provide DSL or cable service with a minimum bandwidth rating of 6 Mbps.
  2. In remote areas where broadband service is not available, provide a dedicated 56 kbps POTS connection.

#### **1.07 PROJECT RECORDS**

- A. The Project Web Site shall be considered the primary mechanism for logged communication between the project team members, but shall not be considered the official record of the project.
- B. The Contractor shall maintain paper copies of all documents stored on the Project Website that it generates. The Contractor shall not be responsible for maintaining paper copies of documents generated by others.
- C. The Contractor shall endeavor to make the electronic project record, as reflected in the content of the Project Web Site, as complete as possible, and shall avoid short-circuiting use of the Project Web Site by using direct e-mail in lieu of comparable applications of the Project Web Site.

#### **1.08 SIGNATURE AUTHORIZATION**

- A. All team members having signatory authority as a representative for their associated organization shall be required to possess a digital signature and provide means to all parties who require such the ability to readily verify its authenticity. The association of digital signatures with electronic documents shall carry the same force as traditional signatures and shall be considered legally binding by all parties.
- B. Individual user accounts will be assigned to all team members having signatory authority as a representative for their associated organization. The security of access to said accounts shall be incumbent upon the party it is assigned to. All statements made using such accounts shall carry the same force as traditional signatures and shall be considered legally binding by all parties.
- C. The Contractor shall have the right to proceed on any action when so directed by the Web Collaboration System through the party having authority by which to do so. This right to proceed shall be considered to carry the weight and burden as if instructed by the authorized party directly.

### **PART 2 PRODUCTS**

#### **2.01 INTERNET COLLABORATION SOFTWARE**

- A. PhiloWilke Partnership's ProjeXtranet project web-site software will be used for this project. A demonstration web-site is available for examination at the web address of <http://apps.pwarch.com/projextranet>. The guest user login ID is "guest", and the password is "pwp-guest".

### **PART 3 EXECUTION**

#### **3.01 PROJECT WEB SITE USAGE**

- A. The Contractor shall be required to monitor the site for updates at reasonable and appropriate intervals, based on the level of activity for the project at the time.
- B. The Owner may require the Contractor to monitor the web site at specifically stated intervals or times, based on the individual project requirements. A requirement to monitor the web site after hours and on weekends SHALL NOT constitute a claim for overtime, nor shall overtime or additional overhead be granted for this requirement. Any requirements related to the

contractor's monitoring of the web-site not stated in this document shall only be deemed as existing when documented within the project web-site.

### **3.02 DOCUMENT FORMATS**

- A. All documents shall be published using a format viewable via the project collaboration viewer. Non digital documents shall be converted to a digital format viewable via the project collaboration viewer.
- B. All documents shall be published using a format that is both viewable and electronically searchable via the project collaboration viewer. Non digital documents shall be converted to a digital format that is both viewable and electronically searchable via the project collaboration viewer.

### **3.03 PROJECT LOGS**

- A. All project related logs (RFI, RFP, Submittal, etc...) shall be maintained in the appropriate section of the project web-site and only these logs shall be considered to be the official logs for the project.

### **3.04 SUBMITTALS**

- A. All documentation concerning proposed materials, equipment and construction methods shall be submitted via the appropriate section of the project website. Product, color and material samples of items being submitted shall be delivered to the appropriate parties as required and documentation relating to these samples shall be submitted via the project web-site. The approval process for all items being submitted shall occur via the project website.

### **3.05 SCHEDULE**

- A. The Contractor's construction schedule shall be published to the appropriate section of the project web-site in a digital format viewable via the project collaboration viewer. The Contractor shall be required to update the project schedule on a weekly basis and at such times as the duration of the "Critical Path" is affected.

### **3.06 CONSTRUCTION DOCUMENTS**

- A. The Web Collaboration tool may have many different versions of design drawings available for review and comment, as part of the development of the project as a whole. The Contractor shall only be responsible, and be contractually obligated for, construction documents located within the designated area of the site for this purpose.

**END OF SECTION**

**SECTION 01 35 53**  
**SECURITY PROCEDURES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Security measures including formal security program, entry control, personnel identification, and miscellaneous restrictions.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 10 00 - Summary: use of premises and occupancy.
- B. Section 01 50 00 - Temporary Facilities and Controls: Temporary lighting.

**1.03 SECURITY PROGRAM**

- A. Protect Work, existing premises and Owner's operations from theft, vandalism, and unauthorized entry.
- B. Initiate program in coordination with Owner's existing security system at project mobilization.
- C. Maintain program throughout construction period until Owner acceptance precludes the need for Contractor security.

**1.04 ENTRY CONTROL**

- A. Restrict entrance of persons into Project site and existing facilities.
- B. Allow entrance only to authorized persons with proper identification.
- C. Maintain log of workers and visitors, make available to Owner on request.
- D. Contractor shall control entrance of persons and vehicles related to Owner's operations.
- E. Coordinate access of Owner's personnel to site in coordination with Owner's security forces.

**1.05 PERSONNEL IDENTIFICATION**

- A. Provide identification badge to each person authorized to enter premises.
- B. Badge To Include: Personal photograph, name, assigned number, expiration date and employer.
- C. Maintain a list of accredited persons, submit copy to Owner on request.
- D. Require return of badges at expiration of their employment on the Work.

**1.06 RESTRICTIONS**

- A. Do not allow cameras on site or photographs taken except by written approval of Owner.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**



**SECTION 01 40 00**  
**QUALITY REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 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 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.
- D. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2013.

**1.03 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.
- 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.
  - 2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.
- 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.
  - 2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.

- E. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

#### **1.04 REFERENCES AND STANDARDS**

- A. For products and 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 current on date of Contract Documents, except where a specific date is established by applicable code.
- C. Obtain copies of standards where required by product specification sections.
- D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.
- F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from the Contract Documents by mention or inference otherwise in any reference document.

#### **1.05 TESTING AND INSPECTION AGENCIES AND SERVICES**

- A. Owner will employ and pay for services of an independent testing agency to perform other specified testing.
- B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

### **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 TOLERANCES**

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

### 3.03 TESTING AND INSPECTION

- A. See individual specification sections for testing required.
- B. 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.
- C. 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.
- D. 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 .
  - 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.
- E. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Architect.
- F. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.
- G. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Architect. Payment for re testing will be charged to the Contractor by deducting testing charges from the Contract Price.

### 3.04 DEFECT ASSESSMENT

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

**END OF SECTION**

**SECTION 01 42 16**  
**DEFINITIONS**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. This section supplements the definitions contained in the General Conditions.
- B. Other definitions are included in individual specification sections.

**1.02 DEFINITIONS**

- A. Furnish: To supply, deliver, unload, and inspect for damage.
- B. Install: To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.
- C. Product: Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.
- D. Project Manual: The book-sized volume that includes the procurement requirements (if any), the contracting requirements, and the specifications.
- E. Provide: To furnish and install.
- F. Supply: Same as Furnish.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

**SECTION 01 60 00**  
**PRODUCT REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Re-use of existing products.
- B. Transportation, handling, storage and protection.
- C. Product option requirements.
- D. Substitution limitations and procedures.
- E. Procedures for Owner-supplied products.
- F. Maintenance materials, including extra materials, spare parts, tools, and software.

**1.02 SUBMITTALS**

- A. Proposed Products List: Submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
  - 1. Submit within 15 days after date of Agreement.
  - 2. For products specified only by reference standards, list applicable reference standards.
- B. 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.
- C. 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.
- D. 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 EXISTING PRODUCTS**

- A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by the Contract Documents.
- B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.
- C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.

**2.02 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. 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. Are extracted, harvested, and/or manufactured closer to the location of the project.
  - 4. Have longer documented life span under normal use.
  - 5. Result in less construction waste.
  - 6. Are made of vegetable materials that are rapidly renewable.
  - 7. Are made of recycled materials.
  - 8. Have a published GreenScreen Chemical Hazard Analysis.

### **2.03 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.

### **2.04 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. Substitutions will only be considered when a product becomes unavailable through no fault of the Contractor.
- B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.
- C. 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.
  - 5. Agrees to reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.
- D. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
- E. Substitution Submittal Procedure (for use when a product becomes unavailable through no fault of the Contractor):
  - 1. Obtain and use Construction Specifications Institute (CSI) Form 13.1A when submitting a substitution request.
  - 2. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution. A single electronic copy is acceptable in lieu of the three paper copies when physical samples are not required.
  - 3. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
  - 4. Substitutions will not be considered if the substitution submittal procedure is not followed.
  - 5. Architect will notify Contractor in writing of decision to accept or reject request.

### **3.02 OWNER-SUPPLIED PRODUCTS**

- A. Owner's Responsibilities:
  - 1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
  - 2. Arrange and pay for product delivery to site.
  - 3. On delivery, inspect products jointly with Contractor.
  - 4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
  - 5. Arrange for manufacturers' warranties, inspections, and service.

- B. Contractor's Responsibilities:
  - 1. Review Owner reviewed shop drawings, product data, and samples.
  - 2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
  - 3. Handle, store, install and finish products.
  - 4. Repair or replace items damaged after receipt.

### **3.03 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.

### **3.04 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. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- J. Prevent contact with material that may cause corrosion, discoloration, or staining.
- K. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- L. 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 61 16

### VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. VOC restrictions for product categories listed below under "DEFINITIONS."
- B. All products of each category that are installed in the project must comply; Owner's project goals do not allow for partial compliance.

##### 1.02 RELATED REQUIREMENTS

- A. Section 01 30 00 - Administrative Requirements: Submittal procedures.
- B. Section 01 40 00 - Quality Requirements: Procedures for testing and certifications.
- C. Section 01 60 00 - Product Requirements: Fundamental product requirements, substitutions and product options, delivery, storage, and handling.

##### 1.03 DEFINITIONS

- A. VOC-Restricted Products: All products of each of the following categories when installed or applied on-site in the building interior:
  - 1. Adhesives, sealants, and sealer coatings.
  - 2. Carpet.
  - 3. Carpet cushion.
  - 4. Carpet tile.
  - 5. Resilient floor coverings.
  - 6. Paints and coatings.
  - 7. Acoustical ceilings and panels.
  - 8. Cabinet work.
  - 9. Other products when specifically stated in the specifications.
- B. Interior of Building: Anywhere inside the exterior weather barrier.
- C. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.
- D. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.

##### 1.04 REFERENCE STANDARDS

- A. GreenSeal GS-36 - Commercial Adhesives; 2011.
- B. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition.

##### 1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.

##### 1.06 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

#### PART 2 PRODUCTS

##### 2.01 MATERIALS

- A. All Products: Comply with the most stringent of federal, State, and local requirements, or these specifications.
- B. Adhesives and Joint Sealants: Provide only products having volatile organic compound (VOC) content not greater than required by South Coast Air Quality Management District Rule No.1168.



1. Evidence of Compliance: Acceptable types of evidence are:
  - a. Report of laboratory testing performed in accordance with requirements.
- C. Aerosol Adhesives: Provide only products having volatile organic compound (VOC) content not greater than required by GreenSeal GS-36.
  1. Evidence of Compliance: Acceptable types of evidence are:
    - a. Current GreenSeal Certification.
- D. Paints and Coatings: Provide products having VOC content as specified in Section 09 9000.

**PART 3 EXECUTION**

**3.01 FIELD QUALITY CONTROL**

- A. Owner reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Owner.
- B. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

**END OF SECTION**

**SECTION 01 70 00**  
**EXECUTION AND CLOSEOUT REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Examination, preparation, and general installation procedures.
- B. Requirements for alterations work, including selective demolition, except removal, disposal, and/or remediation of hazardous materials and toxic substances.
- C. Pre-installation meetings.
- D. Cutting and patching.
- E. Cleaning and protection.
- F. Starting of systems and equipment.
- G. Demonstration and instruction of Owner personnel.
- H. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
- I. General requirements for maintenance service.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 10 00 - Summary: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.
- B. Section 01 30 00 - Administrative Requirements: Submittals procedures, Electronic document submittal service.
- C. Section 01 40 00 - Quality Requirements: Testing and inspection procedures.
- D. Section 01 74 19 - Construction Waste Management and Disposal: Additional procedures for trash/waste removal, recycling, salvage, and reuse.
- E. Section 01 78 00 - Closeout Submittals: Project record documents, operation and maintenance data, warranties and bonds.
- F. Section 07 84 00 - Firestopping.
- G. Individual Product Specification Sections:
  - 1. Advance notification to other sections of openings required in work of those sections.

**1.03 REFERENCE STANDARDS**

- A. 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. 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. Include design drawings and calculations for bracing and shoring.
  - 2. Identify demolition firm and submit qualifications.
  - 3. Include a summary of safety procedures.
- C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
  - 1. Structural integrity of any element of Project.
  - 2. Integrity of weather exposed or moisture resistant element.
  - 3. Efficiency, maintenance, or safety of any operational element.
  - 4. Visual qualities of sight exposed elements.
  - 5. Work of Owner or separate Contractor.
  - 6. Include in request:
    - a. Identification of Project.

- b. Location and description of affected work.
- c. Necessity for cutting or alteration.
- d. Description of proposed work and products to be used.
- e. Alternatives to cutting and patching.
- f. Effect on work of Owner or separate Contractor.
- g. Written permission of affected separate Contractor.
- h. Date and time work will be executed.

D. Project Record Documents: Accurately record actual locations of capped and active utilities.

#### **1.05 QUALIFICATIONS**

- A. For demolition work, employ a firm specializing in the type of work required.
  - 1. Minimum of three years of documented experience.
- B. For field engineering, employ a professional engineer of the discipline required for specific service on Project, licensed in the State in which the Project is located.
- C. For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

#### **1.06 PROJECT CONDITIONS**

- A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- B. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
- C. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
- D. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.
- E. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

#### **1.07 COORDINATION**

- A. See Section 01 10 00 for occupancy-related requirements.
- B. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- C. Notify affected utility companies and comply with their requirements.
- D. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- E. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- G. Coordinate completion and clean-up of work of separate sections.
- H. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

## **PART 2 PRODUCTS**

### **2.01 PATCHING MATERIALS**

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 60 00 - Product Requirements.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

### **3.02 PREPARATION**

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

### **3.03 PREINSTALLATION MEETINGS**

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Architect four days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
  - 1. Review conditions of examination, preparation and installation procedures.
  - 2. Review coordination with related work.
- E. 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.
  - 1. In lieu of distributed copies, the minutes may be posted to the Internet-based collaboration system employed for the Project.

### **3.04 GENERAL INSTALLATION REQUIREMENTS**

- A. In addition to compliance with regulatory requirements, conduct construction operations in compliance with NFPA 241, including applicable recommendations in Appendix A.
- B. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- C. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

- D. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- E. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- F. Make neat transitions between different surfaces, maintaining texture and appearance.

### 3.05 ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
  - 1. Verify that construction and utility arrangements are as shown.
  - 2. Report discrepancies to Architect before disturbing existing installation.
  - 3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
- C. Remove existing work as indicated and as required to accomplish new work.
  - 1. Remove items indicated on drawings.
  - 2. Relocate items indicated on drawings.
  - 3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
  - 4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
- D. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
  - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
  - 2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
  - 3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
    - a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
    - b. See Section 01 10 00 for other limitations on outages and required notifications.
    - c. Provide temporary connections as required to maintain existing systems in service.
  - 4. Verify that abandoned services serve only abandoned facilities.
  - 5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.
- E. Protect existing work to remain.
  - 1. Prevent movement of structure; provide shoring and bracing if necessary.
  - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
  - 3. Repair adjacent construction and finishes damaged during removal work.
  - 4. Patch as specified for patching new work.
- F. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
- G. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect.

- H. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
- I. Where a change of plane of 1/4 inch or more occurs in existing work, submit recommendation for providing a smooth transition for Architect review and request instructions.
- J. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
- K. Refinish existing surfaces as indicated:
- L. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
- M. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.
- N. Clean existing systems and equipment.
- O. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- P. Do not begin new construction in alterations areas before demolition is complete.
- Q. Comply with all other applicable requirements of this section.

### **3.06 CUTTING AND PATCHING**

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. See Alterations article above for additional requirements.
- C. Perform whatever cutting and patching is necessary to:
  1. Complete the work.
  2. Fit products together to integrate with other work.
  3. Provide openings for penetration of mechanical, electrical, and other services.
  4. Match work that has been cut to adjacent work.
  5. Repair areas adjacent to cuts to required condition.
  6. Repair new work damaged by subsequent work.
  7. Remove samples of installed work for testing when requested.
  8. Remove and replace defective and non-conforming work.
- D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- E. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- G. Restore work with new products in accordance with requirements of Contract Documents.
- H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 84 00, to full thickness of the penetrated element.
- J. Patching:
  1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
  2. Match color, texture, and appearance.

3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

### **3.07 PROGRESS CLEANING**

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

### **3.08 PROTECTION OF INSTALLED WORK**

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

### **3.09 SYSTEM STARTUP**

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Architect and owner seven days prior to start-up of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

### **3.10 DEMONSTRATION AND INSTRUCTION**

- A. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.
- B. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.
- C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

- D. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of owner personnel.
- E. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
- F. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

### **3.11 ADJUSTING**

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.

### **3.12 FINAL CLEANING**

- A. Execute final cleaning prior to final project assessment.
  - 1. Clean areas to be occupied by Owner prior to final completion before Owner occupancy.
- B. Use cleaning materials that are nonhazardous.
- C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- F. Clean filters of operating equipment.
- G. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.
- H. Clean site; sweep paved areas, rake clean landscaped surfaces.
- I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

### **3.13 CLOSEOUT PROCEDURES**

- A. Make submittals that are required by governing or other authorities.
  - 1. Provide copies to Architect.
- B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
- C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
- D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
- E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
- F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
- H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.



### **3.14 MAINTENANCE**

- A. Provide service and maintenance of components indicated in specification sections.
- B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than 90 days from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.
- C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
- E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

**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. Section 01 70 00 - Execution and Closeout Requirements: Contract closeout procedures.
- C. Individual Product Sections: Specific requirements for operation and maintenance data.
- D. Individual Product Sections: Warranties required for specific products or Work.

**1.03 SUBMITTALS**

- A. Project Record Documents: Submit documents to Architect .
- 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. Specifications.
  - 3. Addenda.
  - 4. Change Orders and other modifications to the Contract.
  - 5. Reviewed shop drawings, product data, and samples.
  - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.

- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
  - 1. Manufacturer's name and product model and number.
  - 2. Product substitutions or alternates utilized.
  - 3. Changes made by Addenda and modifications.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
  - 1. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
  - 2. Field changes of dimension and detail.
  - 3. Details not on original Contract drawings.

### **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:
  - 1. Product data, with catalog number, size, composition, and color and texture designations.
- 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. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.
- D. Additional information as specified in individual product specification sections.
- E. 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. Provide control diagrams by controls manufacturer as installed.
- J. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.
- K. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- L. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- M. Include test and balancing reports.
- N. 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. Prepare instructions and data by personnel experienced in maintenance and operation of described products.
- D. Prepare data in the form of an instructional manual.
- E. 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.
- F. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- G. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
- H. 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.
- I. 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.
- J. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.
- K. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- L. Arrangement of Contents: Organize each volume in parts as follows:
  - 1. Project Directory.
  - 2. Table of Contents, of all volumes, and of this volume.
  - 3. Operation and Maintenance Data: Arranged by system, then by product category.
    - a. Source data.
    - b. Operation and maintenance data.
    - c. Field quality control data.
    - d. Photocopies of warranties and bonds.
- M. Electronic Versions: Submit approved version of Operation and Maintenance Manuals in searchable electronic format.

1. Submit electronic versions on CD or DVD. Posting or submitting the electronic version to the Project Collaboration Website is also acceptable.
2. File format: PDF version 1.4 or later.
3. Table of Contents: Include hyperlinks for each item in the Table of Contents that links to the listed item in the document.
4. Bookmarks: Include bookmarks in the file corresponding to each tabbed divider of the printed manuals.
5. To the greatest extent possible, provide electronic files in searchable format.
  - a. Text documents: Generally, scanned text documents are not acceptable. If it is not possible to generate a text document using the original software, provide versions that have been processed by optical character recognition software (OCR) to render them searchable.
  - b. Drawings: Vector-based drawings are required for all drawings that were created using Computer Aided Drafting software. Scanned drawings are only acceptable for originals that were created using hand drafting methods.

### **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 02 41 00  
DEMOLITION**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. Selective demolition of building elements for alteration purposes, excluding removal or other abatement of hazardous materials and toxic substances, if any.
- B. Work Not Included:
  - 1. Removal and/or other abatement of hazardous materials, whether previously known, or discovered during operations under this Contract, is specifically excluded from the Work of This Contract, and if determined to be necessary, will be performed by others under separate contract(s) with the Owner.
    - a. No hazardous materials or other toxic substances are known to exist within the Contract limits.

**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 60 00 - Product Requirements: Handling and storage of items removed for salvage and relocation.
- D. 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.

**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.

**PART 2 PRODUCTS -- NOT USED**

**PART 3 EXECUTION**

**3.01 SCOPE**

- A. The general extent of selective demolition work and items to be removed is indicated in the Drawings.
- B. Remove other items indicated, for salvage, relocation, and recycling.

**3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS**

- A. Comply with other requirements specified in Section 01 70 00.
- B. 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.
- C. Do not begin removal until receipt of notification to proceed from Owner.
- D. Do not begin demolition operations until built elements to be salvaged or relocated have been removed.
- 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 in the area of the discovery and notify Architect and Owner immediately; hazardous materials include regulated asbestos containing materials (ACM), lead, PCB's, and mercury. Take precautions to protect workers and other persons from harmful exposure. Removal and/or other abatement of hazardous materials is specifically excluded from the Work of This Contract, and if determined to be necessary, will be performed by others under separate contract(s) with the Owner. Coordinate scheduling and operations under this Contract with those of separate contractors as necessary for timely and satisfactory completion of all work for the Project. Do not resume work under this Contract in the area of the hazardous material discovery until removal or other abatement has been completed.
- H. Perform demolition in a manner that maximizes salvage and recycling of materials.
1. Comply with requirements of Section 01 74 19 - Waste Management.
  2. Dismantle existing construction and separate materials.
  3. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

### **3.03 SELECTIVE DEMOLITION FOR ALTERATIONS**

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
1. Verify that construction and utility arrangements are as shown.
  2. Report discrepancies to Architect before disturbing existing installation.
  3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Separate areas in which demolition is being conducted from other areas that are still occupied.
1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 50 00 in locations indicated on drawings.
- C. Remove existing work as indicated and as required to accomplish new work.
1. Remove items indicated on drawings.
- D. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.

2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
  3. See Section 01 10 00 for other limitations on outages and required notifications.
  4. Verify that abandoned services serve only abandoned facilities before removal.
  5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- E. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
  2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
  3. Repair adjacent construction and finishes damaged during removal work.
  4. Patch as specified for patching new work.

#### **3.04 DEBRIS AND WASTE REMOVAL**

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.

**END OF SECTION**



**SECTION 03 54 00**  
**CAST UNDERLAYMENT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Liquid applied, cementitious (non-gypsum-based) self-leveling floor underlayment.

**1.02 REFERENCE STANDARDS**

- A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2013.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

**1.03 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data sheets documenting physical characteristics and product limitations of underlayment materials. Include information on mixing instructions.
- C. Manufacturer's Instructions: Indicate mix instructions.
- D. Certificate: Certify that products meet or exceed specified requirements.

**1.04 QUALITY ASSURANCE**

- A. Applicator Qualifications: Company specializing in performing the work of this section, and approved by manufacturer.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Keep dry and protect from direct sun exposure, freezing, and ambient temperature greater than 105 degrees F.

**1.06 FIELD CONDITIONS**

- A. Do not install underlayment until floor penetrations and peripheral work are complete.
- B. Maintain minimum ambient temperatures of 50 degrees F 24 hours before, during and 72 hours after installation of underlayment.
- C. During the curing process, ventilate spaces to remove excess moisture.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Cementitious Underlayment:
  - 1. Ardex Engineered Cements Inc.; Ardex K-15 (1/8 to 1-1/2 inch thick, or to 5 inches with aggregate); and/or Ardex Feather Finish (featheredge to 1/8 inch thick): [www.ardexamericas.com](http://www.ardexamericas.com).
  - 2. Dayton Superior Corporation; Econolevel with Level Primer J42: [www.daytonsuperior.com](http://www.daytonsuperior.com).
  - 3. Prospec, an H.B. Fuller brand; Level Set 300: [www.prospec.com](http://www.prospec.com).
  - 4. Koster American Corporation; Koster SL Premium Self-Leveling Underlayment: [www.kosterusa.com](http://www.kosterusa.com).
  - 5. Substitutions: Not permitted.

**2.02 MATERIALS**

- A. Cementitious Underlayment: Blended cement mix, that when mixed with water in accordance with manufacturer's directions will produce self-leveling underlayment with the following properties:
  - 1. Compressive Strength: Minimum 4000 psi after 28 days, tested per ASTM C109/C109M.
  - 2. Final Set Time: 1-1/2 to 2 hours, maximum.

3. Thickness: Capable of thicknesses from feather edge to maximum 3-1/2 inch.
  4. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0 in accordance with ASTM E84.
- B. Water: Potable and not detrimental to underlayment mix materials.
  - C. Primer: Manufacturer's recommended type.
  - D. Joint and Crack Filler: Latex based filler, as recommended by manufacturer.

### **2.03 MIXING**

- A. Site mix materials in accordance with manufacturer's instructions.
- B. Mix to self-leveling consistency without over-watering.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that substrate surfaces are clean, dry, unfrozen, do not contain petroleum byproducts, or other compounds detrimental to underlayment material bond to substrate.

### **3.02 PREPARATION**

- A. Concrete: Mechanically prepare steel troweled concrete to create a textured surface necessary to achieve the best bond; acceptable methods include bead blasting and scarifying. Do not use acid etching.
- B. Remove substrate surface irregularities. Fill voids and deck joints with filler. Finish smooth.
- C. Vacuum clean surfaces.
- D. Prime substrate in accordance with manufacturer's instructions. Allow to dry.
- E. Close floor openings.

### **3.03 APPLICATION**

- A. Install underlayment in accordance with manufacturer's instructions.
- B. Pump or pour material onto substrate. Do not retemper or add water.
  1. Pump, move, and screed while the material is still highly flowable.
  2. Be careful not to create cold joints.
  3. Wear spiked shoes while working in the wet material to avoid leaving marks.
- C. Place to indicated thickness, with top surface level to 1/8 inch in 10 ft.
- D. Place to thickness indicated.
- E. For final thickness over 1-1/2 inches, place underlayment in layers. Allow initial layer to harden to the point where the material has lost its evaporative moisture. Immediately prime and begin application of the subsequent layer within 24 hours.
- F. Place before partition installation.
- G. Where additional aggregate has been used in the mix, add a top layer of neat mix (without aggregate), if needed to level and smooth the surface.
- H. If a fine, feathered edge is desired, steel trowel the edge after initial set, but before it is completely hard.

### **3.04 CURING**

- A. Once underlayment starts to set, prohibit foot traffic until final set has been reached.
- B. Air cure in accordance with manufacturer's instructions.

### **3.05 APPLICATION TOLERANCE**

- A. Top Surface: Level to 1/8 inch in 10 ft.

### **3.06 PROTECTION**

- A. Protect against direct sunlight, heat, and wind; prevent rapid drying to avoid shrinkage and cracking.

B. Do not permit traffic over unprotected floor underlayment surfaces.

**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.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

**1.03 REFERENCE STANDARDS**

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- B. AWI (QCP) - Quality Certification Program; current edition at [www.awiqcp.org](http://www.awiqcp.org).
- C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.
- D. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2009.
- E. UL (DIR) - Online Certifications Directory; current listings at [database.ul.com](http://database.ul.com).

**1.04 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. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
  - 2. Provide the information required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
  - 3. Include certification program label.
- C. Product Data: Provide data for hardware accessories.
- D. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches square, illustrating proposed cabinet substrate and finish.
- E. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.

**1.05 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.
  - 2. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- B. Quality Certification: Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section.
  - 1. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
  - 2. Provide designated labels on shop drawings as required by certification program.
  - 3. Provide designated labels on installed products as required by certification program.
  - 4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
  - 5. Replace, repair, or rework all work for which certification is refused.
  - 6. Arrange and pay for inspections required for certification.

## **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Protect units from moisture damage.

## **1.07 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 CABINETS**

- A. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI//AWMAC/WI (AWS) for Custom Grade.
  - 1. Grain Direction: In Custom and Premium Grade, for veneer and directional laminates, run the grain direction vertically on cabinet doors, drawer fronts, valances, furr-downs, and false fronts.
- B. Wood Veneer Faced Cabinet:
  - 1. Exposed Surfaces: HPVA HP-1 Grade A, White Oak, plain sliced, book-matched.
  - 2. Semi-Exposed Surfaces: HPVA HP-1 Grade B, White Oak, plain sliced, book-matched.
- C. Cabinets:
  - 1. Finish - Exposed Exterior Surfaces: Wood.
  - 2. Finish - Exposed Interior Surfaces: Wood.
  - 3. Finish - Concealed Surfaces: Manufacturer's option.
  - 4. Door and Drawer Front Edge Profiles: Square edge with thick applied band.
  - 5. Door and Drawer Front Retention Profiles: Fixed panel.
  - 6. Casework Construction Type: Type A - Frameless.
  - 7. Interface Style for Cabinet and Door: Style 1 - Overlay; flush overlay.
  - 8. 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.
  - 9. Cabinet Design Series: As indicated on drawings.
  - 10. Adjustable Shelf Loading: 50 lbs. per sq. ft.
    - a. Deflection: L/144.
  - 11. Drawer Side Construction: Multiple-dovetailed.
  - 12. Drawer Construction Technique: Dovetail joints.

### **2.02 WOOD-BASED COMPONENTS**

- A. Wood fabricated from old growth timber is not permitted.

### **2.03 LUMBER MATERIALS**

- A. Softwood Lumber: NIST PS 20; Graded in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Grade II/Custom; average moisture content of 4-9 percent; species as follows:
  - 1. Exposed Surfaces: Species Douglas fir.
  - 2. Semi-Exposed Surfaces: Species Douglas fir.
  - 3. Concealed Surfaces: Species Douglas fir.
- B. Hardwood Lumber: NHLA; Graded in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Grade II/Custom; average moisture content of 4-9 percent; species as follows:
  - 1. Drawer Sides and Back: Species Red Oak, Grade AA.
  - 2. Exposed Surfaces: Species Red Oak.
  - 3. Semi-Exposed Surfaces: Species Poplar.
  - 4. Concealed Surfaces: Species Poplar.

## 2.04 PANEL MATERIALS

- A. Exposed Surfaces: PS 1; APA A-A Grade, plain-sliced redwood face veneer, Interior rated adhesives, core of medium density fiberboard or engineered combination, thickness 1/4 inch.
- B. Medium Density Fiberboard (MDF): ANSI A208.2; type as specified in AWI/AWMAC Architectural Woodwork Quality Standards Illustrated; composed of wood fibers pressure bonded with moisture resistant adhesive to suit application; sanded faces; thickness as required.
  - 1. Use for painted components, concealed components, and components not indicated as another material.
  - 2. Use as backing for plastic laminate unless otherwise indicated.
- C. Hardboard: AHA A135.4; Pressed wood fiber with resin binder, Class 1 - Tempered, 1/4 inch thick, smooth one side (S1S)smooth two sides (S2S); use for dust panels and other components indicated on drawings.

## 2.05 COUNTERTOPS - SEE SECTION 12 36 00 - COUNTERTOPS

## 2.06 ACCESSORIES

- A. Adhesive: Type recommended by fabricator to suit application.
- B. Fasteners: Size and type to suit application.
- C. 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.
- D. Concealed Joint Fasteners: Threaded steel.
- E. Grommets: Basis of Design Product: Hafele No. 429.93.313; [www.hafele.com/us](http://www.hafele.com/us).

## 2.07 HARDWARE

- A. Adjustable Shelf Supports: Standard side-mounted system using drilled holes in cabinet case and coordinated shelf supports, satin chrome finish, for nominal 1 inch spacing adjustments.
  - 1. Basis of Design Product: No. 282.11.710 manufactured by Hafele..
- B. Drawer and Door Pulls: "U" shaped wire pull, steel with satin chrome (US 26D) finish, 3-1/2 inch centers.
  - 1. Basis of Design Product: 348235 manufactured by The Stanley Works.
- C. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish.
  - 1. Basis of Design Product: C8102-KD-26D manufactured by CompX National; [compX.com/national.html](http://compX.com/national.html).
- D. Drawer Slides:
  - 1. Type: Full extension.
  - 2. Static Load Capacity: As required by drawer size and application:
    - a. Box Drawer Slides: 100 lbf.
    - b. Lateral File Drawer Slides: 200 lbf.
    - c. Pencil Drawer Slides: 45 lbf.
  - 3. Mounting: Side mounted.
  - 4. Stops: Integral type.
  - 5. Features: Provide self closing/stay closed type.
  - 6. Manufacturers:
    - a. Basis of Design Products: Accuride International, Inc: [www accuride.com](http://www accuride.com).
      - 1) Box Drawer Slides: Series 3732.
      - 2) Lateral File Drawer Slides: Series 3640A.
      - 3) Pencil Drawer Slides: Series 2632.
    - b. Grass America Inc: [www.grassusa.com](http://www.grassusa.com).
    - c. Knap & Vogt Manufacturing Company: [www.knapeandvogt.com](http://www.knapeandvogt.com).
    - d. Substitutions: Not permitted.

- E. Hinges: European style concealed self-closing type, steel with satin finish, and tool-free attachment. 95 degree opening.
  - 1. Manufacturers:
    - a. Grass America Inc: [www.grassusa.com](http://www.grassusa.com).
    - b. Hardware Resources: [www.hardwareresources.com](http://www.hardwareresources.com).
    - c. Basis of Design: Julius Blum, Inc; Product Clip Top 71T9590B: [www.blum.com](http://www.blum.com).
    - d. Substitutions: Not permitted.

## **2.08 SHOP TREATMENT OF WOOD MATERIALS**

- A. Provide UL (DIR) listed and approved identification on fire retardant treated material.
- B. Deliver fire retardant treated materials cut to required sizes. Minimize field cutting.

## **2.09 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. Matching Wood Grain: Comply with requirements of quality standard for specified Grade and as follows:
- 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.

## **2.10 SHOP FINISHING**

- A. Sand work smooth and set exposed nails and screws.
- B. For opaque finishes, apply wood filler in exposed nail and screw indentations and sand smooth.
- C. On items to receive transparent finishes, use wood filler matching or blending with surrounding surfaces and of types recommended for applied finishes.
- D. Finish work in accordance with AWI/AWMA/WI (AWS) or AWMA/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
  - 1. Transparent:
    - a. System - 4, Latex Acrylic, Water-based.
    - b. Sheen: Satin.

## **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 84 00**  
**FIRESTOPPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 RELATED REQUIREMENTS**

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

**1.03 REFERENCE STANDARDS**

- A. ASTM C679 - Standard Test Method for Tack-Free Time of Elastomeric Sealants, 2015.
- B. ASTM D6904 - Standard Practice for Resistance to Wind-Driven Rain for Exterior Coatings Applied to Masonry, 2013.
- C. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements, 2009
- D. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2015.
- E. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops; 2013a.
- F. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestops; 2014.
- G. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2010a.
- H. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.
- I. ITS (DIR) - Directory of Listed Products; current edition.
- J. FM 4991 - Approval Standard for Firestop Contractors; 2013.
- K. FM (AG) - FM Approval Guide; current edition.
- L. UL 1479 - Standards for Fire Tests of Penetration Firestops, 2015.
- M. 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. Project Record Documents:
  - 1. Firestop Project Report: Upon completion of the firestopping installation (including modifications made during the maintenance phase, if any, included in the Contract), submit a report prepared using manufacturer's firestop documentation manager software documenting the following information for each location where firestopping was installed, including accompanying drawings identifying each firestopping location graphically:
    - a. A unique identification code for each instance.
    - b. The type of assembly penetrated (wall, floor, etc.).
    - c. A description (types, materials and sizes) of penetrating items.
    - d. Assemblies penetrated or joined, their UL (or other) designations and fire ratings.
    - e. Each firestopping product used.
    - f. Photographs of each location before and after installation of firestopping.

2. Furnish the firestop documentation manager system (the software and its initial digital database) to the Owner for use in tracking future firestopping additions and changes. (Instruction in its use is specified in Part 3 Execution.)

#### 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.
  1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
  2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at [www.icc-es.org](http://www.icc-es.org) will be considered as constituting an acceptable test report.
  3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section and:
  1. Trained and accredited or otherwise approved by the firestopping manufacturer.
  2. Approved by Factory Mutual Research Corporation under FM 4991, or certified by Underwriters Laboratories as a UL Certified Contractor.
  3. Licensed by the authority having jurisdiction, if such licensing is required by the AHJ.
- D. Firestop Documentation Management System:
  1. Furnish software for Owner's use in maintaining a database to document and track each installation of firestopping, including future firestopping additions and modifications.
    - a. Software shall consist of, or include, cloud-based iOS-, Android-, and/or Windows-compatible apps for capturing or recording required information in the field using standard tablets and smartphones.
    - b. System shall perform the following basic functions:
      - 1) Create multiple projects/facilities.
      - 2) Add/create/remove users for each project.
      - 3) Define data to track using predefined and custom-generated input fields.
      - 4) Capture pre-installation and post-installation photos of each location.
      - 5) Scan QR codes on manufacturer's labels to link data to each specific location.
      - 6) Annotate (mark) location of each penetration on 2D floor plans.
      - 7) Create reports by filtering data and using report templates.
      - 8) Upload tested designs of firestopping systems and fire-rated assemblies, 2D floor plans, product data, engineering judgments, and other documents.
      - 9) Allow online and offline synchronization of data between mobile devices, online software and cloud-based hosting systems.
      - 10) Allow transfer of ownership of projects from one entity to another, and from construction phase to facility maintenance phase.
    - c. For each instance of firestopping installed, include, identify and/or describe, using brief, consistent terminology, the following:
      - 1) Each location, including its notation on 2D floor plans.
      - 2) Penetrations: assemblies penetrated, their fire ratings, and penetrating items.
      - 3) Joints: the assemblies joined, and their fire ratings.
      - 4) Tested firestopping systems installed, their fire ratings, and products used.
      - 5) If required, firestopping system T-, L-, and/or W-ratings.
      - 6) Pre- and post-installation photos of the assembly and the penetrating items.
      - 7) Installation date.
      - 8) Installer's name.
      - 9) Inspection status.
  2. Firestop Project Report: Generate the initial digital database and the Report to be submitted using the software as specified above, and as specified in Part 3 below.
  3. Instruct the Owner's personnel in use of the System as specified in Part 3 below.

## 1.06 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. Basis of Design Manufacturer: Hilti, Inc: [www.us.hilti.com](http://www.us.hilti.com).
- B. Other Acceptable Manufacturers:
  - 1. 3M Fire Protection Products; \_\_\_\_\_: [www.3m.com/firestop](http://www.3m.com/firestop).
  - 2. Specified Technologies, Inc.; \_\_\_\_\_: [www.stifirestop.com](http://www.stifirestop.com).
  - 3. RectorSeal: [www.rectorseal.com](http://www.rectorseal.com).
  - 4. Substitutions: Not permitted.
- C. Mold Resistance: Provide firestopping materials with mold and mildew resistance rating of 0 as determined by ASTM G21.
- D. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.
- E. Fire Ratings: Refer to drawings for required systems and ratings.

### 2.02 FIRESTOPPING FOR FLOOR-TO-FLOOR, FLOOR-TO-WALL, AND WALL-TO-WALL JOINTS

- A. Concrete and Concrete Masonry Walls and Floors:
  - 1. Floor to Floor Joints:
    - a. 2 Hour Construction: UL System FF-D-1013; Hilti CFS-SP WB Firestop Joint Spray.
  - 2. Top of Wall Joints at Concrete/Concrete Masonry Wall to Concrete Over Metal Deck Floor:
    - a. 2 Hour Construction: UL System HW-D-0181; Hilti CFS-SP WB Firestop Joint Spray.
    - b. 2 Hour Construction: UL System HW-D-1037; Hilti CFS-SP WB Firestop Joint Spray.
  - 3. Top of Wall Joints at Concrete/Concrete Masonry Wall to Concrete Floor:
    - a. 2 Hour Construction: UL System HW-D-0268; Hilti CP 606 Flexible Firestop Sealant.
  - 4. Concrete/Concrete Masonry Wall to Wall Joints:
    - a. 2 Hour Construction: UL System WW-D-0017; Hilti CFS-SP WB Firestop Joint Spray.
    - b. 2 Hour Construction: UL System WW-D-0032; Hilti CP 606 Flexible Firestop Sealant.
- B. Gypsum Board Walls:
  - 1. Wall to Wall Joints:
    - a. 2 Hour Construction: UL System WW-D-0067; Hilti CP 606 Flexible Firestop Sealant.
    - b. 1 Hour Construction: UL System WW-D-0067; Hilti CP 606 Flexible Firestop Sealant.
  - 2. Top of Wall Joints at Underside of Steel Beam and Concrete Over Metal Deck Floor with Sprayed On Fireproofing:
    - a. 2 Hour Construction: UL System HW-D-0259; Hilti CFS-SP WB Firestop Joint Spray.
    - b. 1 Hour Construction: UL System HW-D-0259; Hilti CFS-SP WB Firestop Joint Spray.
  - 3. Top of Wall Joints at Underside of Flat Concrete:
    - a. 2 Hour Construction: UL System HW-D-0209; Hilti CP 606 Flexible Firestop Sealant.
    - b. 1 Hour Construction: UL System HW-D-0209; Hilti CP 606 Flexible Firestop Sealant.
  - 4. Top of Wall Joints at Concrete Over Metal Deck, Wall Parallel to Ribs:
    - a. 2 Hour Construction: UL System HW-D-0049; Hilti CFS-SP WB Firestop Joint Spray.
    - b. 2 Hour Construction: UL System HW-D-0184; Hilti CP 606 Flexible Firestop Sealant.
    - c. 1 Hour Construction: UL System HW-D-0049; Hilti CFS-SP WB Firestop Joint Spray.
    - d. 1 Hour Construction: UL System HW-D-0184; Hilti CP 606 Flexible Firestop Sealant.
  - 5. Top of Wall Joints at Concrete Over Metal Deck, Wall Perpendicular to Ribs, Cut to Fit Ribs:
    - a. 2 Hour Construction: UL System HW-D-0045; Hilti CP 606 Flexible Firestop Sealant.

- b. 1 Hour Construction: UL System HW-D-0045; Hilti CP 606 Flexible Firestop Sealant.
- 6. Top of Wall Joints at Concrete Over Metal Deck, Wall Perpendicular to Ribs, Not Cut to Fit:
  - a. 2 Hour Construction: UL System HW-D-0042; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
  - b. 2 Hour Construction: UL System HW-D-0045; Hilti CP 606 Flexible Firestop Sealant.
  - c. 1 Hour Construction: UL System HW-D-0042; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
  - d. 1 Hour Construction: UL System HW-D-0045; Hilti CP 606 Flexible Firestop Sealant.
- 7. Bottom of Wall Joints:
  - a. 2 Hour Construction: UL System BW-S-0002; BW-S-0023.
  - b. 1 Hour Construction: UL System BW-S-0002; BW-S-0023.

### **2.03 FIRESTOPPING PENETRATIONS THROUGH CONCRETE AND CONCRETE MASONRY CONSTRUCTION**

- A. Blank Openings:
  - 1. In Floors or Walls:
    - a. 2 Hour Construction: UL System C-AJ-0090; Hilti FS-ONE MAX Intumescent Firestop Sealant.
- B. Penetrations Through Floors or Walls By:
  - 1. Multiple Penetrations in Large Openings:
    - a. 2 Hour Construction: UL System C-AJ-8143; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - 2. Uninsulated Metallic Pipe, Conduit, and Tubing:
    - a. 2 Hour Construction: UL System C-AJ-1226; Hilti FS-ONE MAX Intumescent Firestop Sealant.
    - b. 2 Hour Construction: UL System C-AJ-1425; Hilti CFS-S SIL GG Firestop Silicone Sealant Gun-Grade.
  - 3. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
    - a. 2 Hour Construction: UL System System C-AJ-2167; Hilti FS-ONE MAX Intumescent Firestop Sealant.
    - b. 2 Hour Construction: UL System C-AJ-2109; Hilti CP 643N/644 Firestop Collar.
    - c. 2 Hour Construction: UL System C-BJ-2021; Hilti CP 643N Firestop Collar.
  - 4. Electrical Cables Not In Conduit:
    - a. 2 Hour Construction: UL System C-AJ-3216; Hilti CFS-PL Firestop Plug.
    - b. 2 Hour Construction: UL System W-J-3198; Hilti CFS-SL RK Retrofit Sleeve Kit for existing cables.
    - c. 2 Hour Construction: UL System W-J-3199; Hilti CFS-SL SK Firestop Sleeve Kit.
    - d. 2 Hour Construction: UL System C-AJ-3283; Hilti CP653 Speed Sleeve.
  - 5. Cable Trays with Electrical Cables:
    - a. 2 Hour Construction: UL System C-AJ-4094; Hilti CFS-BL Firestop Block.
    - b. 2 Hour Construction: UL System W-J-3200 Multiple Hilti CP653 with Gang Plate
  - 6. Insulated Pipes:
    - a. 2 Hour Construction: UL System C-AJ-5091; Hilti FS-ONE IMAX intumescent Firestop Sealant.
    - b. 2 Hour Construction: UL System C-AJ-5048; Hilti FS-ONE MAX Intumescent Firestop Sealant, CP 606 Flexible Firestop Sealant, CFS-S SIL GG Firestop Silicone Sealant Gun-Grade, or CFS-S SIL SL Firestop Silicone Sealant Self-Leveling.
  - 7. HVAC Ducts, Uninsulated (100 inch x 100 inch maximum duct size):
    - a. 2 Hour Construction: UL System C-AJ-7111 or C-AJ-7154; Hilti FS-ONE MAX Intumescent Firestop Sealant.
- C. Penetrations Through Floors By:
  - 1. Bathtub Drains:

- a. Up to 3 Hour Construction: UL System F-A-1037, F-A-1038, F-A-2094, or F-A-2095; Hilti CP 681 Tub Box Kit.
- 2. Multiple Penetrations in Large Openings:
  - a. 2 Hour Construction: UL System F-A-8012 or CA-J-8143; Hilti CFS-S SIL GG Firestop Silicone Sealant Gun-Grade or CFS-S SIL SL Firestop Silicone Sealant Self-Leveling.
- 3. Uninsulated Metallic Pipe, Conduit, and Tubing:
  - a. 2 Hour Construction: UL System F-A-1016; Hilti CP 680-P/M Cast-In Device.
- 4. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
  - a. 2 Hour Construction: UL System F-A-2065; Hilti CP 680-P Cast-In Device.
  - b. 2 Hour Construction: UL System F-A-2213; Hilti CFS-DID Drop-In Device.
  - c. 2 Hour Construction: UL System F-A-2053; Hilti CP 680-P Cast-In Device.
- 5. Electrical Cables Not In Conduit:
  - a. 2 Hour Construction: UL System F-A-3033; Hilti CP 680-P/M Cast-In Device or CP 653 Speed Sleeve.
  - b. 2 Hour Construction: UL System F-A-3060; Hilti CP 680 and CP 653 Speed Sleeve.
- 6. Electrical Busways:
  - a. 2 Hour Construction: UL System F-A-6002; Hilti CP 604 Self-Leveling Firestop Sealant.
- 7. Insulated Pipes:
  - a. 2 Hour Construction: UL System F-A-5015; Hilti CP 680-P/M Cast-In Device.
  - b. 2 Hour Construction: UL System F-A-5017; Hilti CP 680-P/M Cast-In Device.
- D. Penetrations Through Walls By:
  - 1. Uninsulated Metallic Pipe, Conduit, and Tubing:
    - a. 2 Hour Construction: UL System W-J-1067; Hilti FS-ONE MAX Intumescent Firestop Sealant.
    - b. 1 Hour Construction: UL System W-J-1067; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - 2. Electrical Cables Not In Conduit:
    - a. 2 Hour Construction: UL System W-J-3060; Hilti FS-ONE MAX Intumescent Firestop Sealant.
    - b. 2 Hour Construction: UL System W-J-3143; Hilti CFS-PL Firestop Plug.
    - c. 2 Hour Construction: UL System W-J-3167; Hilti CP653 Speed Sleeve.
  - 3. Insulated Pipes:
    - a. 2 Hour Construction: UL System C-AJ-5090; Hilti FS-ONE MAX Intumescent Firestop Sealant.
    - b. 2 Hour Construction: UL System C-AJ-5091; Hilti FS-ONE MAX Intumescent Firestop Sealant.
    - c. 1 Hour Construction: UL System C-AJ-5090; Hilti FS-ONE MAX Intumescent Firestop Sealant.
    - d. 1 Hour Construction: UL System C-AJ-5091; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - 4. HVAC Ducts, Uninsulated:
    - a. 2 Hour Construction: UL System W-J-7109; Hilti FS-ONE MAX Intumescent Firestop Sealant or CP 606 Flexible Firestop Sealant.
  - 5. HVAC Ducts, Insulated:
    - a. 2 Hour Construction: UL System W-J-7112; Hilti FS-ONE MAX Intumescent Firestop Sealant.

## **2.04 FIRESTOPPING PENETRATIONS THROUGH GYPSUM BOARD WALLS**

- A. Blank Openings:
  - 1. 2 Hour Construction: UL System W-L-3334; Hilti CP 653 Speed Sleeve.
  - 2. 1 Hour Construction: UL System W-L-3334; Hilti CP 653 Speed Sleeve.
- B. Penetrations By:

1. Multiple Penetrations in Large Openings:
  - a. 2 Hour Construction: UL System W-L-1408; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - b. 2 Hour Construction: UL System W-L-8071; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - c. 2 Hour Construction: UL System W-L-8079; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - d. 2 Hour Construction: UL System W-L-8013; Hilti CFS-BL Firestop Block.
  - e. 1 Hour Construction: UL System W-L-1408; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - f. 1 Hour Construction: UL System W-L-8071; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - g. 1 Hour Construction: UL System W-L-8079; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - h. 1 Hour Construction: UL System W-L-8013; Hilti CFS-BL Firestop Block.
2. Uninsulated Metallic Pipe, Conduit, and Tubing:
  - a. 2 Hour Construction: UL System W-L-1054; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - b. 2 Hour Construction: UL System W-L-1164; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - c. 1 Hour Construction: UL System W-L-1054; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - d. 1 Hour Construction: UL System W-L-1164; Hilti FS-ONE MAX Intumescent Firestop Sealant.
3. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
  - a. 2 Hour Construction: UL System W-L-2078; Hilti CP 643N/644 Firestop Collar.
  - b. 2 Hour Construction: UL System W-L-2128; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - c. 1 Hour Construction: UL System W-L-2078; Hilti CP 643N/644 Firestop Collar.
  - d. 1 Hour Construction: UL System W-L-2128; Hilti FS-ONE MAX Intumescent Firestop Sealant.
4. Electrical Cables Not In Conduit:
  - a. 2 Hour Construction: UL System W-L-3065; Hilti FS-ONE MAX Intumescent Firestop Sealant, CP 606 Flexible Firestop Sealant, CFS-S SIL GG Elastomeric Firestop Sealant, or CP 618 Firestop Putty Stick.
  - b. 2 Hour Construction: UL System W-L-3334; Hilti CP 653 Speed Sleeve.
  - c. 2 Hour Construction: UL System W-L-3393; Hilti CFS-SL RK Retrofit Sleeve Kit for existing cables.
  - d. 2 Hour Construction: UL System W-L-3395; Hilti CP653 Speed Sleeve.
  - e. 1 Hour Construction: UL System W-L-3393; Hilti CFS-SL RK Retrofit Sleeve Kit for existing cables.
  - f. 1 Hour Construction: UL System W-L-3065; Hilti FS-ONE MAX Intumescent Firestop Sealant, CP 606 Flexible Firestop Sealant, CD 601S Elastomeric Firestop Sealant, or CP 618 Firestop Putty Stick.
  - g. 1 Hour Construction: UL System W-L-3334; Hilti CP 653 Speed Sleeve.
5. Cable Trays with Electrical Cables:
  - a. 2 Hour Construction: UL System W-L-4011; Hilti CFS-BL Firestop Block.
  - b. 2 Hour Construction: UL System W-L-4060; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - c. 1 Hour Construction: UL System W-L-4011; Hilti CFS-BL Firestop Block.
  - d. 1 Hour Construction: UL System W-L-4060; Hilti FS-ONE MAX Intumescent Firestop Sealant.
6. Insulated Pipes:
  - a. 2 Hour Construction: UL System W-L-5028; Hilti FS-ONE MAX Intumescent Firestop Sealant.

- b. 2 Hour Construction: UL System W-L-5029; Hilti FS-ONE Intumescent Firestop Sealant.
  - c. 1 Hour Construction: UL System W-L-5028; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - d. 1 Hour Construction: UL System W-L-5029; Hilti FS-ONE Intumescent Firestop Sealant.
7. HVAC Ducts, Insulated (100 inches x 100 inches maximum uninsulated duct size):
- a. 2 Hour Construction: UL System W-L-7155 or W-L-7156; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - b. 1 Hour Construction: UL System W-L-7155 or W-L-7156; 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 (AG), 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.
- C. Install backing materials to arrest liquid material leakage.

### **3.03 INSTALLATION**

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by Owner's Independent Testing Agency.
- C. Do not cover installed firestopping until inspected by authorities having jurisdiction.
- D. Labeling: Install manufacturer's labeling to surfaces adjacent to and within 6 inches of the edge of each firestopping installation so labels will be visible to anyone seeking to remove or alter joints, penetrating items and/or firestopping. Each label shall include a unique QR code identifying attributes of each penetration, meet applicable code labeling requirements, and be scannable by the manufacturer's readily-available firestop documentation software (such as Hilti CF-DM).

### **3.04 FIELD QUALITY CONTROL**

- A. Independent Testing Agency: An independent inspection agency employed and paid by Owner will examine joint and penetration firestopping in accordance with ASTM E2174, "Standard Practice for On-Site Inspection of Installed Fire Stops and ASTM E2393, "Standard Practice for On-Site Inspection of Installed Fire Stop Joint Systems.
- B. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

### **3.05 INSTRUCTION**

- A. Firestop Documentation Management System: Instruct the owner's designated personnel in use of the furnished firestop documentation management software, including but not limited to input of added or revised firestopping data using phone or tablet apps in the field, and editing to document changes and generate updated complete and/or partial firestop project reports. Base instruction on published software documentation including printed instructions for use.

**3.06 CLEANING**

- A. Clean adjacent surfaces of firestopping materials.

**3.07 PROTECTION**

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

**END OF SECTION**



**SECTION 07 92 00**  
**JOINT SEALANTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Nonsag gunnable joint sealants.
- B. Joint backings and accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions: Additional requirements for sealants and primers.

**1.03 REFERENCE STANDARDS**

- A. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants; 2015.
- B. ASTM C834 - Standard Specification for Latex Sealants; 2014.
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.
- D. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2000 (Reapproved 2011).
- E. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.
- F. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2002 (Reapproved 2013).

**1.04 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
  - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
  - 2. List of backing materials approved for use with the specific product.
  - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
  - 4. Substrates the product should not be used on.
  - 5. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
  - 6. Sample product warranty.
- C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
- D. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least two physical samples for verification of color of each required sealant.
- E. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.
- F. Field Quality Control Plan: Submit at least two weeks prior to start of installation.
- G. Field Quality Control Log: Submit filled out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.

- C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.
- D. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
  - 1. Adhesion Testing: In accordance with ASTM C794.
  - 2. Compatibility Testing: In accordance with ASTM C1087.
  - 3. Allow sufficient time for testing to avoid delaying the work.
  - 4. Deliver to manufacturer sufficient samples for testing.
  - 5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
  - 6. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.
- E. Field Quality Control Plan:
  - 1. Visual inspection of entire length of sealant joints.
  - 2. Field testing agency's qualifications.
  - 3. Field Quality Control Log Form: Show same data fields as on Preinstallation Field Adhesion Test Log, with known information filled out and lines for multiple tests per sealant/substrate combinations; include visual inspection and specified field testing; allow for possibility that more tests than minimum specified may be necessary.

## 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.
- C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

## PART 2 PRODUCTS

### 2.01 JOINT SEALANT APPLICATIONS

- A. Scope:
  - 1. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
    - a. Joints between door, window, and other frames and adjacent construction.
    - b. Other joints indicated below.
  - 2. Do not seal the following types of joints.
    - a. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
    - b. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
    - c. Joints where installation of sealant is specified in another section.
    - d. Joints between suspended panel ceilings/grid and walls.
- B. Interior Joints: Use non-sag polyurethane sealant, Type \_\_\_\_, unless otherwise indicated.
  - 1. Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant; Type I-1.
  - 2. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; clear; Type I-2.
  - 3. In Sound-Rated Assemblies: Acrylic emulsion latex sealant; Type I-1.
  - 4. Narrow Control Joints in Interior Concrete Slabs: Self-leveling epoxy sealant; Type I-4.
- C. Interior Wet Areas: Bathrooms and restrooms; fixtures in wet areas include plumbing fixtures, countertops, cabinets, and other similar items.
- D. Sound-Rated Assemblies: Walls and ceilings identified as "STC-rated", "sound-rated", or "acoustical".

## **2.02 JOINT SEALANTS - GENERAL**

- A. Sealants and Primers: Provide products with levels of volatile organic compound (VOC) content as indicated in Section 01 61 16.

## **2.03 NONSAG JOINT SEALANTS**

- A. Type I-2 - Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
  - 1. Color: Clear.
  - 2. Manufacturers:
    - a. Basis of Design: Tremsil 200 manufactured by Tremco, Inc.:  
www.tremcosealants.com..
    - b. Substitutions: Not permitted.
- B. Type I-1 - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
  - 1. Color: Standard colors matching finished surfaces, Type OP (opaque).
  - 2. Grade: ASTM C834; Grade - 0 Degrees C.
  - 3. Manufacturers:
    - a. Basis of Design: Tremflex 834 manufactured by Tremco, Inc.:  
www.tremcosealants.com..
    - b. Substitutions: Not permitted.

## **2.04 SELF-LEVELING SEALANTS**

### **2.05 ACCESSORIES**

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
  - 1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type C - Closed Cell Polyethylene.
  - 2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type C - Closed Cell Polyethylene.
  - 3. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.
  - 4. Manufacturers:
    - a. Basis of Design: Kool-Rod manufactured by W.R. Meadows, Inc.:  
www.wrmeadows.com..
    - b. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
- D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.
- E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.

### **3.02 PREPARATION**

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.
- E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in inconspicuous area to verify that it 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. 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.
- D. Install bond breaker backing tape where backer rod cannot be used.
- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- F. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

### **3.04 FIELD QUALITY CONTROL**

- A. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.
- B. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

**END OF SECTION**

**SECTION 08 12 13**  
**HOLLOW METAL FRAMES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Non-fire-rated hollow metal frames for non-hollow metal doors.
- B. Interior glazed borrowed lite frames.

**1.02 RELATED REQUIREMENTS**

- A. Section 08 14 16 - Flush Wood Doors: Non-hollow metal door for hollow metal frames.
- B. Section 08 71 00: Hardware and silencers.
- C. Section 08 80 00 - Glazing: Glazed borrowed lites.
- D. Section 09 91 23 - INTERIOR PAINTING: Field painting.

**1.03 REFERENCE STANDARDS**

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.
- C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.
- D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
- 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 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.
- H. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2014.
- I. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.
- J. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- K. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
- L. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; 2007.
- M. 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 grade standard.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.
- 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 of documented experience.
- B. Maintain at the project site a copy of all reference standards dealing with installation.

## **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Store in accordance with applicable requirements and in compliance with standards and/or custom guidelines as indicated.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Hollow Metal Frames with Integral Casings:
  - 1. Republic Doors: [www.republicdoor.com](http://www.republicdoor.com).
  - 2. Steelcraft, an Allegion brand: [www.allegion.com/us](http://www.allegion.com/us).
  - 3. Substitutions: Not permitted.

### **2.02 DESIGN CRITERIA**

- A. Refer to Door Type Schedule on the drawings for frame sizes, fire ratings, sound ratings, finishing, door hardware to be installed, and other variations, if any.
- B. Door Frame Type: Provide hollow metal door frames with integral casings.
- C. Steel used for fabrication of frames shall comply with one or more of the following requirements; Galvanized 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.
- D. Accessibility: Comply with ICC A117.1 and ADA Standards.
- E. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturers standard.
- F. 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 frame that is also indicated as being sound-rated must comply with the requirements specified for exterior frames and for sound-rated frames; where two requirements conflict, comply with the most stringent.
- G. Hardware Preparations, Selections and Locations: Comply with BHMA A156.115, NAAMM HMMA 830 and NAAMM HMMA 831 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- H. Mullions for Pairs of Doors: Fixed, except where removable is indicated, with profile similar to jambs.
- I. Frames for Interior Glazing or Borrowed Lites: Construction and face dimensions to match door frames, and as indicated on drawings.
- J. Frames Installed Back-to-Back: Reinforce with steel channels anchored to floor and overhead structure.
- K. Frames Wider than 48 Inch: Reinforce with steel channel fitted tightly into head of frame, flush with top.

### **2.03 HOLLOW METAL DOOR FRAMES WITH INTEGRAL CASINGS**

- A. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
  - 1. Grade: Comply with frame requirements in ANSI/SDI A250.8 (SDI-100); Level 2 - Heavy-Duty, 16 gage, 0.053 inch, minimum frame steel thickness.
- B. Interior Door Frames, Fire-Rated: Fully welded type.

1. Grade: Comply with frame requirements in ANSI/SDI A250.8 (SDI-100); Level 2 - Heavy-Duty, 16 gage, 0.053 inch, minimum frame steel thickness.
2. Frame Finish: Factory primed and field finished.

#### **2.04 ACCESSORIES**

- A. 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.
- B. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.
- C. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

#### **2.05 FINISHES**

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

### **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 INSTALLATION**

- A. Install frames in accordance with manufacturer's instructions and related requirements of specified 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. Comply with glazing installation requirements of Section .
- E. Install door hardware as specified in Section .
- F. Coordinate installation of electrical connections to electrical hardware items.

#### **3.03 TOLERANCES**

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

**END OF SECTION**

**SECTION 08 14 16**  
**FLUSH WOOD DOORS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 RELATED REQUIREMENTS**

- A. Section 08 12 13 - Hollow Metal Frames.
- B. Section 08 71 00 - DOOR HARDWARE.
- C. Section 08 80 00 - Glazing
- D. Section 09 91 23 - INTERIOR PAINTING: Field finishing of doors.

**1.03 REFERENCE STANDARDS**

- A. AWI (QCP) - Quality Certification Program; current edition at [www.awiqcp.org](http://www.awiqcp.org).
- B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.
- D. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2016.

**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.
  - 1. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
- D. Specimen warranty.
- E. Samples: Submit two samples of door veneer, 6 x 6 inches in size illustrating plastic laminate pattern and color.
- F. Warranty, executed in Owner's name.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of experience.
  - 1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- B. Quality Certification: Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section.
  - 1. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
  - 2. Provide designated labels on shop drawings as required by certification program.
  - 3. Provide labels on each product on top rail when required by certification program.
  - 4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
  - 5. Arrange and pay for inspections required for certification.
  - 6. Replace, repair, or rework all work for which certification is refused.

**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 PROJECT CONDITIONS**

- A. Coordinate the work with door opening construction, door frame and door hardware installation.

### **1.08 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. Wood Veneer Faced Doors:
  - 1. Eggers Industries; Product: Flush Series: [www.eggersindustries.com](http://www.eggersindustries.com).
  - 2. Basis of Design: VT Industries, Inc.; Product 5502A and 5P02A according to rating required [www.vtindustries.com](http://www.vtindustries.com).
  - 3. Assa Abloy Wood Doors: Product: Premium Flush Wood Doors: <http://www.assaabloywooddoors.com>.
  - 4. Substitutions: Not permitted.

### **2.02 DOORS**

- A. Doors: Refer to drawings for locations and additional requirements.
  - 1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
  - 2. Wood Veneer Faced Doors: 7-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. Wood veneer facing for field transparent finish as indicated on drawings.

### **2.03 DOOR AND PANEL CORES**

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type bonded particleboard core (PC), plies and faces as indicated above.

### **2.04 DOOR FACINGS**

- A. Veneer Facing for Transparent Finish: White oak, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
  - 1. Vertical Edges: Match existing doors.
- B. Facing Adhesive: Type I - waterproof.

### **2.05 DOOR CONSTRUCTION**

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
- C. Provide solid blocks at lock edge and top of door for closer for hardware reinforcement.
  - 1. Provide solid blocking for other throughbolted hardware.
- D. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
- E. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- F. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

G. Provide edge clearances in accordance with the quality standard specified.

## **2.06 FACTORY FINISHING - WOOD VENEER DOORS**

- A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
  - 1. Transparent:
    - a. System - 4, Latex Acrylic, Water-based.
    - b. Sheen: Satin.
- B. Factory finish doors in accordance with approved sample.
- C. Seal door top edge with transparent sealer to match door facing.

## **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 smoke and draft control doors in accordance with NFPA 105 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.

### **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 71 00**  
**DOOR HARDWARE**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Hardware for wood doors.
- B. Electrically operated and controlled hardware.
- C. Weatherstripping, seals and door gaskets.

**1.02 RELATED REQUIREMENTS**

- A. Section 08 12 13 - Hollow Metal Frames.
- B. Section 08 14 16 - Flush Wood Doors.

**1.03 REFERENCE STANDARDS**

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- C. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.
- D. BHMA A156.1 - American National Standard for Butts and Hinges; 2013.
- E. BHMA A156.2 - American National Standard for Bored and Preassembled Locks & Latches; 2011.
- F. BHMA A156.26 - American National Standard for Continuous Hinges; 2012.
- G. BHMA A156.3 - American National Standard for Exit Devices; 2014.
- H. BHMA A156.4 - American National Standard for Door Controls - Closers; 2013.
- I. BHMA A156.6 - American National Standard for Architectural Door Trim; 2010.
- J. BHMA A156.7 - American National Standard for Template Hinge Dimensions; 2014.
- K. BHMA A156.8 - American National Standard for Door Controls - Overhead Stops and Holders; 2010.
- L. BHMA A156.15 - American National Standard for Release Devices - Closer Holder, Electromagnetic and Electromechanical; 2011.
- M. BHMA A156.17 - American National Standard for Self Closing Hinges & Pivots; 2014.
- N. BHMA A156.18 - American National Standard for Materials and Finishes; 2012.
- O. BHMA A156.21 - American National Standard for Thresholds; 2014.
- P. BHMA A156.22 - American National Standard for Door Gasketing and Edge Seal Systems, Builders Hardware Manufacturers Association; 2012.
- Q. BHMA A156.31 - American National Standard for Electric Strikes and Frame Mounted Actuators; 2013.
- R. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2014.
- S. BHMA A156.115W - Hardware Preparation in Wood Doors with Wood or Steel Frames; 2006.
- T. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames; 2004.
- U. DHI WDHS.3 - Recommended Locations for Architectural Hardware for Flush Wood Doors; 1993; also in WDHS-1/WDHS-5 Series, 1996.
- V. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.
- W. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.

- X. NFPA 101 - Life Safety Code; 2015.
- Y. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- Z. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

#### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate the manufacture, fabrication, and installation of products that door hardware will be installed upon.
- B. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.
- C. Convey Owner's keying requirements to manufacturers.
- D. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; require attendance by all affected installers.
- E. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

#### **1.05 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project. Do not include literature for products that do not occur in this project.
- C. Hardware Schedule: Detailed listing of each item of hardware to be installed on each door. Use door numbering scheme as included in the Contract Documents. Identify electrically operated items and include power requirements.
  - 1. Where only Door Types and Hardware Sets are indicated on the Drawings, identify each door using the Room Number of the room it swings into followed by a single lower-case letter, starting with "a" at the northmost door and proceeding clockwise around the room for additional doors. For doors that swing to the exterior, or sliding doors on the exterior wall, identify each door with the letter "X" followed by a sequential number starting from "1" at the northmost door, and proceeding clockwise around the perimeter of the building.
- D. Keying Schedule: Submit for approval of Owner.
- E. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.
- F. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
- G. Keys: Deliver with identifying tags to Owner by security shipment direct from hardware supplier.
- H. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- I. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.
- J. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
  - 2. Tools: One set of all special wrenches or tools applicable to each different or special hardware component, whether supplied by the hardware component manufacturer or not.

#### **1.06 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of experience.
- B. Hardware Supplier Qualifications: Company specializing in supplying the type of products specified in this section with at least three years experience and approved by manufacturer.

- C. Hardware Supplier Personnel: Employ an Architectural Hardware Consultant (AHC) to assist in the work of this section.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Package hardware items individually; label and identify each package with door opening code to match hardware schedule.

#### **1.08 WARRANTY**

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year warranty for door closers.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS - BASIS OF DESIGN**

- A. Basis of Design Manufacturers and Products: As specified in this section for each type of product.
- B. Additional acceptable manufacturers are specified in this section for each type of product.
- C. Substitutions: Not permitted.

#### **2.02 GENERAL REQUIREMENTS**

- A. Provide door hardware specified, or as required to make doors fully functional, compliant with applicable codes, and secure to the extent indicated.
- B. Provide items of a single type of the same model by the same manufacturer.
- C. Provide products that comply with the following:
  - 1. Applicable provisions of federal, state, and local codes.
  - 2. Accessibility: ADA Standards and ICC A117.1.
  - 3. Applicable provisions of NFPA 101, Life Safety Code.
  - 4. Fire-Rated Doors: NFPA 80.
  - 5. Hardware on Fire-Rated Doors: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.
  - 6. Hardware Preparation for Steel Doors and Steel Frames: BHMA A156.115.
  - 7. Hardware Preparation for Wood Doors with Wood or Steel Frames: BHMA A156.115W.
  - 8. Hardware for Smoke and Draft Control Doors (Indicated as "S" on Drawings): Provide hardware that enables door assembly to comply with air leakage requirements of the applicable code.
  - 9. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.
- D. Function: Lock and latch function numbers and descriptions of manufactures series as listed in hardware schedule.
- E. Electrically Operated and/or Controlled Hardware: Provide and install all power supplies, power transfer hinges, relays, and interfaces required for proper operation; provide and install wiring between hardware and control components and to building power connection.
  - 1. Provide power required for all electrically operated door hardware, whether a circuit is identified for opening on the Electrical Drawings or not. If a circuit is not identified in the Drawings, request a clarification from the Architect. Under no circumstances will additional time or additional cost be allowed based on an unidentified electrical circuit for door hardware that is indicated to require an electrical connection.
- F. Finishes: Provide door hardware of the same finish unless otherwise indicated.
  - 1. Primary Finish: Satin chrome plated over nickel on brass or bronze, 626 (approx US26D).
  - 2. Secondary Finish: Satin chrome plated over nickel on brass or bronze, 626 (approx US26D).
    - a. Use secondary finish in kitchens, bathrooms, and other spaces containing chrome or stainless steel finished appliances, fittings, and equipment; provide primary finish on one side of door and secondary finish on other side if necessary.

3. Finish Definitions: BHMA A156.18.
4. Exceptions:
  - a. Where base metal is specified to be different, provide finish that is an appearance equivalent according to BHMA A156.18.
  - b. Hinges for Fire-Rated Doors: Steel base metal with plated finish.
  - c. Door Closer Covers and Arms: Color to be selected by Architect from manufacturer's standard colors.
  - d. Aluminum Surface Trim and Gasket Housings: Anodized to match door, not to match other hardware.
  - e. Hardware for Aluminum Storefront Doors: Finished to match door, except hand contact surfaces to be satin stainless steel.

G. Fasteners:

1. Mineral Core Wood Doors: Sex bolts.

## 2.03 LOCKS AND LATCHES

A. Locksets - General:

1. Provide cylindrical locksets, Grade 1, wherever locksets are called for, unless otherwise indicated.
2. On fire-rated and smoke-rated doors, provide products complying with:
  - a. UL (DIR) labeled and listed for functions up to 3 hours for "A" label and for single doors up to 48 inches in width and up to 96 inches in height.
  - b. UL 10C, positive pressure rated.
3. Doors: Comply with ADA Standards and ICC A117.1.
4. Lock and Latch Chassis: Zinc dichromate.
5. Latch Bolts: Stainless steel; 1/2 inch minimum throw and deadlocking.
  - a. Standard Backset: 2-3/4 inches.
  - b. Faceplate: Adjustable for square door edge or 1/8 inch beveled door edge.
6. Keyed Functions: Freewheeling, vandal-resistant.
7. Handing: Non-handed, field reversible.
8. Lead Lining: 1/16 inch thick lead applied to lock and wrapped around latch bolt.
9. Mounting: Through-bolted with no exposed screws.

B. Trim:

1. Levers: Cast zinc; plated to match finish designation specified in Section 08 71 00.
2. Tactile Warning: Knurled levers on entry side of doors into potentially dangerous areas or spaces.
  - a. Electrical Rooms, Mechanical Rooms, Medical Gas Storage Rooms.
3. Roses: Solid brass.

C. Locks: Provide a lock for every door, unless specifically indicated as not requiring locking.

1. Hardware Sets indicate locking functions required for each door.
2. If no hardware set is indicated for a swinging door provide an office lockset.
3. Trim: Provide lever handle or pull trim on outside of all locks unless specifically stated to have no outside trim.
4. Lock Cylinders: Provide key access on outside of all locks unless specifically stated to have no locking or no outside trim.
5. In door sections, where a lock cylinder referenced to this Section is specified, furnish and install a mortise lock cylinder keyed to the building keying system.

D. Electric Locks:

1. Fail Safe, Electronic Locking (EL): Outside trim unlocked when power is switched off or fails.
2. Fail Secure, Electrically Unlocked (EU): Outside trim locked when power is switched off or fails.
3. Continuous duty solenoids.
4. 24VDC, 24VAC, 150ma.

5. Latchbolt Monitoring (LM): Single switch, single-pole, double-throw (SPDT) mounted inside lockset monitors full extension of latchbolt.
  6. Door Position Monitor (DPM): Single switch, single-pole, double-throw (SPDT) Reed magnetic switch mounted inside lockset monitors whether door is fully closed.
  7. Request to Exit (RX): Monitors inside lever rotation.
  8. Power Supply: UL (DIR) listed, filtered and regulated 24V with 2 amp capacity; protection for overload, over voltage, and short circuits; surge suppression on Fail Safe and Fail Secure outputs; suitable for 120 VAC and 240 VAC in same unit.
- E. Electrically Operated Locks: Fail secure unless otherwise indicated.
- F. Lock Cylinders: Manufacturer's standard tumbler type, seven-pin interchangeable core.
1. Provide cams and/or tailpieces as required for locking devices required.
- G. Keying: Grand master keyed.
1. Include construction keying.
  2. Supply keys in the following quantities:
    - a. 10 master keys.
    - b. 5 grand master keys.
    - c. 3 construction keys.
    - d. 2 change keys for each lock.
  3. When providing keying information, comply with DHI Handbook "Keying systems and nomenclature".
- H. Latches: Provide a latch for every door that is not required to lock, unless specifically indicated "push/pull" or "not required to latch".
1. Hospital Latchset: Passage latchset function with paddle-style trim. Provide only on doors indicated to receive a hospital-style latchset.

## 2.04 HINGES

- A. Fire Rated Hinges: UL (DIR) listed up to and including 90-minute applications for wood doors and up to 3-hour applications for metal doors.
- B. Self Closing Hinges: Comply with BHMA A156.17.
1. Basis of Design: Hager Companies: Spring Hinges, 1250.
  2. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:
    - a. Assa Abloy Brands; McKinney: [www.assaabloydss.com](http://www.assaabloydss.com).
    - b. Stanley Black & Decker: [www.stanleyblackanddecker.com](http://www.stanleyblackanddecker.com).
  3. Substitutions: Not permitted.
- C. Hinges: Provide hinges on every swinging door.
1. Provide square corner five-knuckle full mortise butt hinges unless otherwise indicated.
  2. Provide ball-bearing hinges at all doors having closers.
  3. Provide hinges in the quantities indicated.
  4. Provide non-removable pins on exterior outswinging doors.
  5. Provide non-removable pins on outswinging interior doors at access controlled doors.
  6. Where electrified hardware is mounted in door leaf, provide power transfer hinges.
  7. Provide 5 inch heavy weight hinges for doors over 36 inches in width.
  8. Provide full height aluminum continuous geared hinges at all cross corridor double egress doors and pairs of doors normally held open
- D. Butt Hinges: Comply with BHMA A156.1 and A156.7; heavy weight, unless otherwise indicated.
1. Provide hinge width required to clear surrounding trim, 4 1/2 inch high minimum.
  2. Quantity of Hinges Per Door:
    - a. Doors up to 60 inches High: Two hinges.
    - b. Doors From 60 inches High up to 90 inches High: Three hinges.
    - c. Doors 90 inches High up to 120 inches High: Four hinges.
    - d. Door 48 inches Wide: Minimum of four hinges.

- e. Doors over 120 inches High: One additional hinge per each additional 30 inches in height.
- f. Dutch Doors: Two hinges each leaf.
- 3. Non-Removable Pins (NRP): At out-swinging exterior and out-swinging access controlled doors.
- 4. Doors Requiring Full Width Clear Openings: Hinges swing door clear of opening when open 95 degrees from wall.
- 5. Shimming: Where required to correct frame or door irregularities, provide metal shims only.
- 6. Manufacturers - Butt Hinges:
  - a. Basis of Design: Assa Abloy Brands; McKinney: [www.assaabloydss.com](http://www.assaabloydss.com).
  - b. Hager Companies: [www.hagerco.com](http://www.hagerco.com).
  - c. Stanley Black & Decker: [www.stanleyblackanddecker.com](http://www.stanleyblackanddecker.com).
  - d. Substitutions: Not permitted.
- E. Power Transfer Hinges: Where indicated as Electric Through Wire (ETW), provide hinges certified to handle an amperage rating of 3.5 A continuous duty with 16.0 A intermittent duty; with appropriate number of wires to transfer power through door frame to door and then to electrified door hardware.
  - 1. Basis of Design Product: McKinney T4A3786 QC8.
  - 2. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:
    - a. Assa Abloy Brands; McKinney: [www.assaabloydss.com](http://www.assaabloydss.com).
    - b. Stanley Black & Decker: [www.stanleyblackanddecker.com](http://www.stanleyblackanddecker.com).
    - c. Hager Companies.
  - 3. Substitutions: Not Permitted.
- F. Continuous Geared Hinges: Complying with BHMA A156.26.
  - 1. Size and Thickness:
    - a. Thickness: As recommended by manufacturer for weight of door and finish hardware applied to door; door location and frequency of usage.
    - b. Size: 1 inch less than door height.
  - 2. Base Material: Aluminum extrusion; ASTM B221 (ASTM B221M), alloy 6063 and temper T6, clear anodized finish. Coat unexposed working metal surfaces with tetrafluoroethylene (TFE) dry lubricant.
  - 3. Locations: Provide continuous hinges at doors indicated to receive them in the Hardware Schedule and the following locations:
    - a. Cross corridor doors that are normally held open.
    - b. Lead lined doors that do not receive pivots.
  - 4. Manufacturers and Products:
    - a. Basis of Design: Hager Companies: Heavy Weight Hinges with Door Edge Protection Lip, 780-224HD.
    - b. Other acceptable manufacturers:
      - 1) Assa Abloy Brands; McKinney: [www.assaabloydss.com](http://www.assaabloydss.com).
      - 2) Stanley Black & Decker: [www.stanleyblackanddecker.com](http://www.stanleyblackanddecker.com).
    - c. Substitutions: Not Permitted.

## 2.05 PIVOTS

- A. Pivots - Basis of Design: Assa Abloy Brands; McKinney or Rixson: [www.assaabloydss.com](http://www.assaabloydss.com)..
- B. Pivots: Comply with BHMA A156.17.
- C. Other Manufacturers: Provide either products from the manufacturer identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:
  - 1. Ives, an Allegion brand: [www.allegion.com/us](http://www.allegion.com/us).
  - 2. Architectural Builders Hardware Mfg. Inc.: [www.abhmfg.com](http://www.abhmfg.com)
- D. Substitutions: Not permitted.



## 2.06 PUSH/PULLS

- A. Push/Pulls: Comply with BHMA A156.6.
  - 1. Provide push and pull on doors not specified to have lockset, latchset, exit device, or auxiliary lock.
  - 2. On solid doors, provide matching push plate and pull plate on opposite faces.
- B. Push Plates and Pull Plates: 0.050 inch thick, aluminum.
  - 1. Push Plates: Square corner and beveled edges with counter sunk screw holes.
    - a. Width and Height: As scheduled.
    - b. Manufacturers:
      - 1) Hager Companies: 30S.
      - 2) Rockwood: 70.
      - 3) Trimco: 1001.
  - 2. Pull Plates: Square corner and beveled edges.
    - a. Width and Height: As scheduled.
    - b. Pull: 1 inch diameter; 2-1/2 inch clearance from face of door.
    - c. Manufacturers:
      - 1) Hager Companies: H34.
      - 2) Rockwood: 105 x 70.
      - 3) Trimco: 1017.
  - 3. Substitutions: Not Permitted.
- C. Push/Pull Sets: 1 inch diameter, round stainless steel bar stock.
  - 1. Clearance: 2-1/2 inches from face of door.
  - 2. Offset: 3 inches; 90-degree standard.
  - 3. Center to Center: Door width less 1 stile width.
  - 4. Manufacturers:
    - a. Push Bar / Offset Pull Set:
      - 1) Hager Companies: H160D.
      - 2) Basis of Design: Rockwood: BF15847.
      - 3) Trimco: 1191E04 x 1741E.
    - b. Offset Pull:
      - 1) Hager Companies: H12L.
      - 2) Rockwood: BF158.
      - 3) Trimco: 1191E-4.
    - c. Straight Pull:
      - 1) Hager Companies: H4L.
      - 2) Rockwood: BF112.
      - 3) Trimco: 1195E-3.
  - 5. Substitutions: Not Permitted.

## 2.07 CYLINDRICAL LOCKSETS

- A. Locking Functions: As defined in BHMA A156.2, and as follows.
  - 1. Passage: No locking, always free entry and exit.
  - 2. Privacy: F76, emergency tool unlocks.
    - a. Hospital Privacy: Unlocks with emergency pushbutton or thumb turn on outside.
  - 3. Office: F82 Grade 1, key not required to lock, unlocks upon exit.
  - 4. Intruder Classroom: F110, keyed both sides.
  - 5. Communicating: F80 or F113.
  - 6. Hotel: F93.
  - 7. Always-Locked: F86, key required to lock, may not be left unlocked.
  - 8. Two-Key Entry: F88, outside locked by key from both sides, free egress
  - 9. Store Door: F91, locked by key from both sides, not an emergency exit (must be unlocked during occupied hours).
  - 10. Exit Only: F89, may not be left unlocked.

- B. Manufacturers - Cylindrical Locksets:
  - 1. Basis of Design - Sargent: 10 Line: [www.assaabloydss.com](http://www.assaabloydss.com).
    - a. Lever Design: B.
    - b. Rose: L.
  - 2. Hager Companies: 3400 Series, with Archer trim: [www.hagerco.com](http://www.hagerco.com).
  - 3. Schlage, an Allegion brand: ND Series: [www.allegion.com/us](http://www.allegion.com/us).
  - 4. Substitutions: Not permitted.
- C. Keypad Locks:
  - 1. Basis of Design: Sargent KP Series with key override. [www.assaabloydss.com](http://www.assaabloydss.com).
  - 2. Provide the Basis of Design product or an equivalent product from one of the manufacturers listed for Cylindrical Locksets.
  - 3. Substitutions: Not Permitted.

## 2.08 AUXILIARY ELECTRICAL ACCESS CONTROL DEVICES

- A. Proximity / Pin Reader: Standalone reader; HID compatible; wall mounted.
  - 1. Provide access up to 650 card users.
  - 2. Weather resistant two-piece enclosure.
  - 3. Access mode selectable for proximity card only, proximity card plus pin number, or key in card number only.
  - 4. Key pad programmable without software or computer.
  - 5. Key pad lockout and flashing red LED activated when wrong password is entered more than five times.
  - 6. Lock and alarm outputs relays programmable to 1 to 99 seconds or on-off latching.
  - 7. Power Supply: UL (DIR) listed, filtered and regulated 24V with 1 amp capacity; protection for overload, over voltage, and short circuits; surge suppression on Fail Safe and Fail Secure outputs; for 120 VAC or 240 VAC in same unit.
  - 8. Manufacturers:
    - a. Allegion: AptiQ MTK15.
    - b. Hager Companies: 2920.
    - c. Security Door Controls (SDC): E4KP.
    - d. Substitutions: Not Permitted.

## 2.09 FLUSHBOLTS AND COORDINATORS

- A. Flushbolts: Lever extension bolts in leading edge of door, one bolt into floor, one bolt into top of frame.
  - 1. Pairs of Swing Doors: At inactive leaves, provide flush bolts of type as required to comply with code.
  - 2. Floor Bolts: Provide dustproof strike except at metal thresholds.
- B. Manual Flushbolts: Provide lever extensions for top bolt at over-size doors and inactive leaf of unequal pairs of doors.
- C. Automatic Flushbolts: Automatically latch upon closing of door; automatic retraction of bolts when active leaf is opened.
- D. Coordinators: Provide on doors having closers and self-latching or automatic flushbolts to ensure that leaves close in proper order.
- E. Manual, Self-Latching, and Automatic Flush Bolts:
  - 1. Basis of Design: Rockwood: 555 / 557 / 1842 / 1942 / 1962 / 570.
  - 2. Trimco: 3917 / 3913 / 3810 / 3815 / 3911.
  - 3. Substitutions: Not Permitted.
- F. Coordinators:
  - 1. Basis of Design: Rockwood: 1600 / 1601C / 1601AB.
  - 2. Trimco: 3094 / 3096 / 3095.
  - 3. Substitutions: Not Permitted.

## 2.10 ELECTRIC STRIKES

- A. Electric Strikes: Complying with BHMA A156.31 and UL (DIR) listed as a Burglary-Resistant Electric Door Strike; style to suit locks.
- B. Manufacturers - Electric Strikes:
  - 1. Assa Abloy Brands, Securitron; UNL Series: [www.assaabloydss.com](http://www.assaabloydss.com).
  - 2. Substitutions: Not permitted.

## 2.11 EXIT DEVICES

- A. Locking Functions: Functions as defined in BHMA A156.3, and as follows:
  - 1. Entry/Exit, Always-Unlocked: Outside lever unlocked, no outside key access, no latch holdback.
  - 2. Entry/Exit, Free Swing: Key outside retracts latch, latch holdback (dogging) for free swing during occupied hours, not fire-rated; outside trim must be specified as lever or pull.
  - 3. Entry/Exit, Always-Latched: Key outside locks and unlocks lever, no latch holdback (dogging).
  - 4. Entry/Exit, Always-Locked: Key outside retracts latchbolt but does not unlock lever, no latch holdback.
  - 5. Exit Only, Secure: No outside trim, no key entry, no latch holdback, deadlocking latchbolt.
- B. Exit Devices: Touch-pad type; complying with BHMA A156.3 Grade 1; UL (DIR) labeled for fire and panic; finished to match balance of hardware.
  - 1. Width: One-half door width, minimum.
  - 2. Covers and Caps: Brass.
  - 3. Chassis: Aluminum.
  - 4. Keyed Functions: Freewheeling, vandal resistant; lever style and design to match other locksets in project.
  - 5. Fasteners: Wood screws, machine screws and through bolts.
  - 6. Mounting: Flush with door; minimum door stile width:
    - a. Pair with Surface Vertical Rod Devices: 5 inches.
    - b. Single: 5-3/8 inches.
    - c. Pair with Rim Devices and Removable Mullion: 5 inches.
    - d. Pair with Rim Devices and Fixed Frame Mullion: 5-3/4 inches.
- C. Manufacturers - Exit Devices:
  - 1. Basis of Design: Assa Abloy Brands, Sargent; 80 Series: [www.assaabloydss.com](http://www.assaabloydss.com).
  - 2. Hager Companies; 4500 Series: [www.hagerco.com](http://www.hagerco.com).
  - 3. Von Duprin, an Allegion brand; 98/99 Series: [www.allegion.com/us](http://www.allegion.com/us).
  - 4. Substitutions: Not permitted.

## 2.12 CLOSERS

- A. Closers - Basis of Design: Sargent 1330/1130 Series.
- B. Closers: Complying with BHMA A156.4.
  - 1. Provide surface-mounted, door-mounted closers unless otherwise indicated.
  - 2. Provide a door closer on every exterior door.
  - 3. Provide a door closer on every fire- and smoke-rated door. Spring hinges are not an acceptable self-closing device unless specifically so indicated.
  - 4. On pairs of swinging doors, if an overlapping astragal is present, provide coordinator to ensure the leaves close in proper order.
  - 5. At corridors, locate door-mounted closer on room side of door.
  - 6. At outswinging exterior doors, mount closer in inside of door.
- C. Surface-Mounted, Door-Mounted Closers: Non-handed, comply with BHMA A156.4, Grade 1, with aluminum body and full plastic covers.
  - 1. Comply with Following:
    - a. ICC A117.1 and ADA Standards.
    - b. UL (DIR) listed for up to three hour Fire-Rated.

- c. UL 10C; Positive Pressure Fire Rated.
  - 2. Springs: Double heat-treated, tempered steel.
  - 3. Piston: Precision-machined, heat-treated steel.
  - 4. Spindle: Triple heat-treated steel.
  - 5. Operation: Full rack and pinion.
  - 6. Adjustment: Separate, staked, adjustable valve screws for latch speed, sweep speed, and backcheck.
  - 7. Arms and Brackets:
    - a. Arm Type: Manufacturer's standard.
    - b. Mounting Types: Manufacturer's standard "Tri-Pack" of regular arm, top jamb arm and parallel arm.
  - 8. Size: Comply with referenced standard for accessibility, including following maximum opening force requirements.
    - a. Interior hinged openings: 5.0 pounds.
    - b. Exterior hinged openings: 8.5 pounds.
    - c. Fire Rated Openings: Minimum opening force allowable by authority having jurisdiction.
  - 9. Fasteners: Provide self-reaming and self-tapping wood and machine screws and sex nuts and bolts for each closer.
- D. Manufacturers: Aluminum Body, Surface Mounted Closers.
- 1. Hager Companies: 5200/5300 Series.
  - 2. Norton: 8000 Series.
  - 3. Substitutions: Not permitted.

### **2.13 STOPS AND HOLDERS**

- A. Stops: Complying with BHMA A156.8 Grade 1; provide a stop for every swinging door, unless otherwise indicated.
- 1. Provide wall stops, unless otherwise indicated.
  - 2. If wall stops are not practical, due to configuration of room or furnishings, provide overhead stop.
  - 3. Stop is not required if positive stop feature is specified for door closer; positive stop feature of door closer is not an acceptable substitute for a stop unless specifically so stated.
  - 4. For overhead stop/holder on mineral core wood doors, provide sex bolt attachments.
- B. Manufacturers: Wall Stops.
- 1. Hager Companies: 232W/236W.
  - 2. Basis of Design: Rockwood: 406/409.
  - 3. McKinney: WS01.
  - 4. Substitutions: Not permitted.
- C. Manufacturers: Overhead Stops/holders.
- 1. Basis of Design: Rockwood OH100 Series.
  - 2. Hager Companies: 7000 CON Series, heavy duty concealed.
  - 3. Glynn Johnson: 100 Series, heavy duty concealed.
  - 4. Substitutions: Not permitted.
- D. Magnetic Holder/Releases: Complying with BHMA A156.15; fail safe; doors release to close automatically when electrical current is interrupted; holding force: 25 to 40 pounds-force.
- E. Manufacturers: Magnetic Holder/Releases.
- 1. Basis of Design: Rixon: 900 Series.
  - 2. Hager Companies: 380 Series.
  - 3. LCN, an Allegion brand: 7000 Series.
  - 4. Substitutions: Not permitted.

### **2.14 GASKETING AND THRESHOLDS**

- A. Gaskets: Complying with BHMA A156.22.

1. On each door in smoke partition, provide smoke gaskets; top, sides, and meeting stile of pairs. If fire/smoke partitions are not indicated on drawings, provide smoke gaskets on each door identified as a "smoke door" and 20-minute rated fire doors.
  2. On wood doors with fire rating more than 20-minutes, provide frame-applied intumescent gaskets.
  3. On each exterior door, provide weatherstripping gaskets, unless otherwise indicated; top, sides, and meeting stiles of pairs.
    - a. Where exterior door is also required to have fire or smoke rating, provide gaskets functioning as both smoke and weather seals.
  4. On each exterior door, provide door bottom sweep, unless otherwise indicated.
  5. On doors indicated as "sound-rated", "acoustical", or with an STC rating, provide sound-rated gaskets and automatic door bottom; make gaskets completely continuous, do not cut or notch gaskets for installation.
  6. On doors indicated as "lightproof", provide gaskets similar to smoke gaskets.
- B. Smoke Gaskets: Complying with NFPA 105; listed, labeled, and acceptable to authorities having jurisdiction for smoke control.
1. Perimeter: Press-on, concealed:
    - a. Basis of Design: Pemko S44D.
    - b. McKinney: MCKS44D.
    - c. Substitutions: Not permitted.
- C. Fire-Rated Gaskets: Frame-applied intumescent seals for Category B wood doors.
1. Provide products complying with:
    - a. NFPA 80; listed, labeled, and acceptable to authorities having jurisdiction, for fire ratings indicated.
    - b. Positive Pressure: UBC 7-2 and UL10C.
  2. Product: McKinney MCKHSS2000 x MCKS44D.
  3. National Guard: 96.
  4. Pemko: 57.
  5. National Guard: 513/896.
  6. Pemko: 271/2005.
  7. Substitutions: Not permitted.
- D. Thresholds: Complying with BHMA A156.21.
1. At each exterior door, provide a threshold unless otherwise indicated.
  2. Field cut threshold to frame for tight fit.
  3. Provide threshold configuration as indicated on the drawings, or where not indicated:
    - a. Provide 1/2 inch by 5 inch saddle type barrier free threshold at doors where no change in floor finish thickness occurs.
    - b. Provide 1/2 inch by 5 inch half saddle type barrier free thresholds where interior side of door has a finish floor thickness of 1/2 inch or more.
    - c. Provide 1/2 inch by 5 inch barrier free threshold with silicone gasket at outswinging mechanical room doors.
  4. Finish: Mill finish aluminum.
  5. Manufacturers - Thresholds:
    - a. Basis of Design: National Guard Products: [www.ngp.com](http://www.ngp.com).
    - b. Hager Companies: [www.hagerco.com](http://www.hagerco.com).
    - c. Pemko Manufacturing Co: [www.pemko.com](http://www.pemko.com)
    - d. Substitutions: Not permitted.
- E. Fasteners At Exterior Locations: Non-corroding.

## **2.15 PROTECTION PLATES AND ARCHITECTURAL TRIM**

- A. Comply with BHMA A156.6.
- B. Trim: Provide 0.050 inch thick aluminum; beveled four edges and with countersunk holes.
  1. Single Doors:

- a. Provide 2 inch less door width (LDW) on push side of door and 1 inch less door width (LDW) on pull side of door.
- b. Kickplate: 8 inches high.
- c. Armor Plate: 36 inches high.
- d. Edge Guards: Match net door height, non-mortise type.
- 2. Pair of Doors: Provide 1 inch less door width (LDW) on push side of door, and 1/2 inch less door width (LDW) on pull side of door.
- C. Fasteners: Supply No. 6 by 5/8 inch long oval head screws, unless otherwise noted.
- D. Manufacturers:
  - 1. Protection Plates: McKinney KP50 HB4E CSK.
  - 2. Edge Guards: Rockwood 306B.
  - 3. Rockwood: K1050 x B4E.
  - 4. Substitutions: Not permitted.
- E. Drip Guard: Provide projecting drip guard over all exterior doors unless they are under a projecting roof or canopy.

## **2.16 KEY CONTROLS**

- A. Key Management System: For each keyed lock on project, provide one set of consecutively numbered duplicate key tags with hanging hole and snap catch.
  - 1. Security Key Tags: For each keyed lock on project, provide one set of matching key tags for permanent attachment to one key of each set.
  - 2. Provide key collection envelopes, receipt cards, and index cards in quantity suitable to number of keys to be managed.
- B. Facility Manager's Key Cabinet: Sheet steel construction, piano hinged door with key lock.
  - 1. Mounting: Wall-mounted.
  - 2. Capacity: Actual quantity of keys, plus 25 percent additional capacity.
  - 3. Horizontal metal hook strips with replaceable labels covered with clear plastic.
  - 4. Size key hooks to hold 6 keys each.
  - 5. Finish: Baked enamel, manufacturer's standard color.
  - 6. Key cabinet lock to building keying system.

## **2.17 SILENCERS**

- A. Silencers: Gray rubber, shaped for specific door type and application.
  - 1. Metal Doors: 1/4 inch diameter.
  - 2. Wood Doors: 3/8 inch wide by 3/4 inch long.
  - 3. Silencers: Three silencers per single door frame, two per double door frame and four per Dutch door frame where smoke, light, weather or acoustical seals not otherwise required.
- B. Manufacturers:
  - 1. McKinney: S1M.
  - 2. Hager Companies: 307D/308D.
  - 3. Rockwood: 608/609.
  - 4. Trimco: 1229A/1229B.
  - 5. Substitutions: Not permitted.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that doors and frames are ready to receive work; labeled, fire-rated doors and frames are present and properly installed, and dimensions are as indicated on shop drawings.
- B. Verify that electric power is available to power operated devices and of the correct characteristics.

### **3.02 INSTALLATION**

- A. Install hardware in accordance with manufacturer's instructions and applicable codes.

- B. Use templates provided by hardware item manufacturer.
- C. Do not install surface mounted items until finishes applied to substrate are complete.
- D. Install hardware on fire-rated doors and frames in accordance with code and NFPA 80.
- E. Mounting heights for hardware from finished floor to center line of hardware item. As indicated in the following list; unless noted otherwise in Door Hardware Sets Schedule or on the drawings.
  - 1. For steel doors and frames: Comply with DHI (LOCS) "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames".
  - 2. For Wood Doors: Comply with DHI WDHS.3 "Recommended Locations for Architectural Hardware for Flush Wood Doors".
- F. Set exterior door thresholds with full-width bead of elastomeric sealant on each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

### **3.03 FIELD QUALITY CONTROL**

- A. Provide an Architectural Hardware Consultant to inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

### **3.04 ADJUSTING**

- A. Adjust work under provisions of Section 01 70 00 - Execution and Closeout Requirements.
- B. Adjust hardware for smooth operation.
- C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

### **3.05 CLEANING**

- A. Clean adjacent surfaces soiled by hardware installation. Clean finished hardware per manufacturer's instructions after final adjustments has been made. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

### **3.06 PROTECTION**

- A. Protect finished Work under provisions of Section 01 70 00 - Execution and Closeout Requirements.
- B. Do not permit adjacent work to damage hardware or finish.

**HARDWARE SETS - SEE HARDWARE SCHEDULE ON THE DRAWINGS**

**END OF SECTION**

## SECTION 08 80 00

### GLAZING

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Glazing units.
- B. Glazing compounds and accessories.

##### 1.02 RELATED REQUIREMENTS

- A. Section 08 12 13 - Hollow Metal Frames: Glazed borrowed lites.
- B. Section 08 14 16 - Flush Wood Doors: Glazed lites in doors.

##### 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 C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2011).
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.
- E. ASTM C1036 - Standard Specification for Flat Glass; 2011.
- F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
- G. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2014.
- H. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.
- I. GANA (GM) - GANA Glazing Manual; 2009.
- J. GANA (SM) - GANA Sealant Manual; 2008.

##### 1.04 ADMINISTRATIVE REQUIREMENTS

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

##### 1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.
- D. Samples: Submit two samples 12 by 12 inches in size of glass units, showing coloration and design.
- E. Samples: Submit 12 inch long bead of glazing sealant, color as selected.
- F. Certificate: Certify that products of this section meet or exceed specified requirements.

##### 1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA (GM) and GANA (SM) for glazing installation methods.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.



## 1.07 WARRANTY

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

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Float Glass Manufacturers:
  - 1. Cardinal Glass Industries: [www.cardinalcorp.com](http://www.cardinalcorp.com).
  - 2. Guardian Industries Corp.: [www.sunguardglass.com](http://www.sunguardglass.com).
  - 3. Pilkington North America Inc: [www.pilkington.com/na](http://www.pilkington.com/na).
  - 4. PPG Industries, Inc: [www.ppgideascapescapes.com](http://www.ppgideascapescapes.com).
  - 5. Substitutions: Not permitted.

### 2.02 GLASS MATERIALS

- A. Float Glass: Provide float glass based glazing unless noted otherwise.
  - 1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality-Q3.
  - 2. Heat-Strengthened and Fully Tempered Types: ASTM C1048, Kind HS and FT.
  - 3. Fully Tempered Safety Glass: Complies with ANSI Z97.1 and 16 CFR 1201 criteria.
  - 4. Tinted Type: ASTM C1036, Class 2 - Tinted, Quality-Q3, color and performance characteristics as indicated.
  - 5. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.
- B. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
  - 1. Laminated Safety Glass: Complies with ANSI Z97.1 and 16 CFR 1201 test requirements for Category II.
  - 2. Polyvinyl Butyral (PVB) Interlayer: 0.030 inch thick, minimum.

### 2.03 GLAZING UNITS

- A. Type G-1 - Monolithic Interior Vision Glazing:
  - 1. Applications: Interior glazing unless otherwise indicated.
  - 2. Glass Type: Heat-strengthened float glass. Provide fully tempered safety float glass at locations adjacent to doors or within 18 inches vertically of a walking surface.
  - 3. Tint: Clear.
  - 4. Thickness: 1/4 inch, nominal.
  - 5. Glazing Method: Gasket glazing.
- B. Type SG-1 - Monolithic Safety Glazing: Non-fire-rated.
  - 1. Applications:
    - a. Glazed lites in doors, except fire doors.
    - b. Sliding glass doors.
    - c. Glazed sidelights to doors, except in fire-rated walls and partitions or where Types IG-1 or SG-1 are indicated.
    - d. Other locations required by applicable federal, state, and local codes and regulations.
    - e. Other locations indicated on drawings.
  - 2. Glass Type: Fully tempered safety glass as specified.
  - 3. Tint: Clear.
  - 4. Thickness: 1/4 inch, nominal.
  - 5. Glazing Method: Gasket glazing.

### 2.04 GLAZING COMPOUNDS

- A. Type GC-2 - Butyl Sealant: Single component; ASTM C920, Grade NS, Class 12-1/2, Uses M and A, Shore A hardness of 10 to 20; black color.
- B. Type GC-5 - Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C920, Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.
- C. Manufacturers:

1. Dow Corning Corporation: [www.dowcorning.com/construction](http://www.dowcorning.com/construction).
2. Momentive Performance Materials, Inc, exclusive licensee of General Electric: [www.siliconeforbuilding.com/sle](http://www.siliconeforbuilding.com/sle).
3. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
4. Tremco Commercial Sealants and Waterproofing: [www.tremcosealants.com](http://www.tremcosealants.com)..
5. Substitutions: Not permitted.

## **2.05 ACCESSORIES**

- A. Setting Blocks: Neoprene, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.
- C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 10 to 15 cured Shore A durometer hardness; coiled on release paper; black color.
  1. Width: As required for application.
  2. Thickness: As required for application.
  3. Spacer Rod Diameter: As required for application.
  4. Manufacturers:
    - a. Basis of Design: Pecora Corporation: [www.pecora.com](http://www.pecora.com).
    - b. Tremco Commercial Sealants and Waterproofing: [www.tremcosealants.com](http://www.tremcosealants.com).
    - c. Substitutions: Not permitted.
- D. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.
- E. Glazing Clips: Manufacturer's standard type.

## **PART 3 EXECUTION**

### **3.01 VERIFICATION OF CONDITIONS**

- A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
- B. Verify that the minimum required face and edge clearances are being provided.
- C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.
- D. Verify that sealing between joints of glass framing members has been completed effectively.
- E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

### **3.02 PREPARATION**

- A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

### **3.03 INSTALLATION, GENERAL**

- A. Install setting blocks, glass, gaskets, sealants and other glazing materials in compliance with manufacturers' written instructions, unless more stringent requirements are indicated, including those in glazing referenced standards.
- B. Install glazing materials in accordance with ASTM C1193, GANA (GM), and GANA (SM).

- C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
- D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.
- E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.
- F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

#### **3.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)**

- A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

#### **3.05 INSTALLATION - WET GLAZING METHOD (COMPOUND AND COMPOUND)**

- A. Application - Interior Glazed: Set glazing infills from the interior of the building.
- B. Install glazing resting on setting blocks. Install applied stop and center pane by use of spacer shims at 24 inch centers, kept 1/4 inch below sight line.
- C. Locate and secure glazing pane using glazers' clips.
- D. Fill gaps between glazing and stops with glazing compound until flush with sight line. Tool surface to straight line.

#### **3.06 INSTALLATION - WET/DRY GLAZING METHOD (PREFORMED TAPE AND SEALANT)**

- A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.
- B. Cut glazing tape to length and set against permanent stops, 3/16 inch below sight line. Seal corners by butting tape and dabbing with butyl sealant.
- C. Apply heel bead of butyl sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete the continuity of the air and vapor seal.
- D. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- E. Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to attain full contact at perimeter of pane or glass unit.
- F. Install removable stops, with spacer strips inserted between glazing and applied stops 1/4 inch below sight lines.
  - 1. Place glazing tape on glazing pane of unit with tape flush with sight line.
- G. Fill gap between glazing and stop with silicone type sealant to depth equal to bite of frame on glazing, but not more than 3/8 inch below sight line.
- H. Apply cap bead of silicone type sealant along void between the stop and the glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

#### **3.07 FIELD QUALITY CONTROL**

- A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
- B. Monitor and report installation procedures and unacceptable conditions.

#### **3.08 CLEANING**

- A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
- B. Remove non-permanent labels immediately after glazing installation is complete.

- C. Clean glass and adjacent surfaces after sealants are fully cured.
- D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

**3.09 PROTECTION**

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.
- B. Remove and replace glass that is damaged during construction period prior to Date of 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. Acoustic insulation.
- 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.

**1.03 REFERENCE STANDARDS**

- A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- C. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.
- D. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.
- E. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- 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 C1278/C1278M - Standard Specification for Fiber-Reinforced Gypsum Panel; 2007a (Reapproved 2011).
- K. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014.
- L. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels; 2013.
- M. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2012.
- N. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- O. ASTM E413 - Classification for Rating Sound Insulation; 2010.
- P. GA-216 - Application and Finishing of Gypsum Board; 2013.
- Q. GA-226 - Application of Gypsum Board to Form Curved Surfaces; Gypsum Association; 2008.
- R. GA-600 - Fire Resistance Design Manual; 2015.
- S. ICC (IBC) - International Building Code; 2015.
- T. UL (FRD) - Fire Resistance Directory; current edition.

#### **1.04 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.
- C. Product Data: Provide data on metal framing, gypsum board, glass mat faced gypsum board, accessories, and joint finishing system.
- D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- E. 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.
- F. Samples: Submit two samples of gypsum board finished with proposed texture application, 12 by 12 inches in size, illustrating finish color and texture.

#### **1.05 QUALITY ASSURANCE**

- A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum five (5) years of experience.

### **PART 2 PRODUCTS**

#### **2.01 GYPSUM BOARD ASSEMBLIES**

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
  - 1. See PART 3 for finishing requirements.
- B. Interior Partitions Indicated as Acoustic ("S" suffix in the Partition Type Indicator): Provide completed assemblies with the following characteristics:
  - 1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- C. Fire Rated Assemblies: Provide completed assemblies indicated on the Drawings and with the following characteristics:
  - 1. ICC IBC Item Numbers: Comply with applicable requirements of ICC IBC for the particular assembly.
  - 2. Gypsum Association File Numbers: Comply with requirements of GA-600 for the particular assembly.
  - 3. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

#### **2.02 METAL FRAMING MATERIALS**

- A. Manufacturers - Metal Framing, Connectors, and Accessories:
  - 1. Basis of Design: Clarkwestern Dietrich Building Systems LLC: [www.clarkdietrich.com](http://www.clarkdietrich.com).
  - 2. Marino: [www.marinoware.com](http://www.marinoware.com).
  - 3. Phillips Manufacturing Company: [www.phillipsmfg.com](http://www.phillipsmfg.com).
  - 4. Substitutions: Not permitted.
- B. 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/120 at 5 psf.
  - 1. Studs: "C" shaped with flat or formed webs.
  - 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 (attached side down, open side up).
    - a. Products:
      - 1) Same manufacturer as other framing materials.
      - 2) Substitutions: Not permitted.

- C. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
  - 1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
  - 2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot dipped galvanized coating.
  - 3. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems indicated on drawings.
  - 4. Deflection and Firestop Track:
    - a. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-rating of the wall assembly.
    - b. Products:
      - 1) FireTrak Corporation; Posi Klip.
      - 2) Metal-Lite, Inc.; The System.
      - 3) Substitutions: Not permitted.

### 2.03 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
  - 1. Georgia-Pacific Gypsum: [www.gpgypsum.com](http://www.gpgypsum.com).
  - 2. National Gypsum Company: [www.nationalgypsum.com](http://www.nationalgypsum.com).
  - 3. Basis of Design: USG Corporation: [www.usg.com](http://www.usg.com).
  - 4. Substitutions: Not permitted.
- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
  - 1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
  - 2. Optional: Glass-mat-faced gypsum panels as defined in ASTM C1658/C1658M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
  - 3. Unfaced fiber-reinforced gypsum panels as defined in ASTM C1278/C1278M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
  - 4. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
    - a. Mold resistant board is required at all locations.
  - 5. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
  - 6. Thickness:
    - a. Vertical Surfaces: 5/8 inch.
    - b. Multi-Layer Assemblies: Thicknesses as indicated on drawings.
  - 7. Paper-Faced Products:
    - a. Georgia-Pacific Gypsum; ToughRock.
    - b. National Gypsum Company; Gold Bond Brand Gypsum Wallboard.
    - c. Basis of Design: USG Corporation; Sheetrock Brand Gypsum Panels.
    - d. Substitutions: Not permitted.
  - 8. Mold Resistant Paper Faced Products:
    - a. Georgia-Pacific Gypsum; ToughRock Mold-Guard.
    - b. Georgia-Pacific Gypsum; ToughRock Fireguard X Mold-Guard.
    - c. National Gypsum Company; Gold Bond Brand XP Gypsum Board.
    - d. Basis of Design: USG Corporation; Sheetrock Brand Mold Tough Gypsum Panels.
    - e. Substitutions: Not permitted.
  - 9. Unfaced Products:
    - a. Basis of Design: USG Corporation; Fiberock Aqua-Tough Interior Panels.
    - b. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Impact Resistant Wallboard:

1. Application: High-traffic areas indicated.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. Paper-Faced Type: Gypsum wallboard as defined in ASTM C1396/C1396M.
4. Unfaced Type: Interior fiber-reinforced gypsum panels as defined in ASTM C1278/C1278M.
5. Type: Fire resistance rated Type X, UL or WH listed.
6. Thickness: 5/8 inch.
7. Edges: Tapered.
8. Products:
  - a. National Gypsum Company; Gold Bond Hi-Impact Brand XP Wallboard.
  - b. Basis of Design: USG Corporation; Fiberock Brand Panels--VHI Abuse-Resistant.
  - c. Substitutions: See Section 01 60 00 - Product Requirements.

## **2.04 ACCESSORIES**

- A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 1 1/2 inch.
- B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
- C. Joint Materials: ASTM C475/C475M 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.
  4. Chemical hardening type compound.
- D. High Build Drywall Surfacers: 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.
  1. Products:
    - a. Basis of Design, PPG Paints: SpeedHide MaxBuild High Build Drywall Surfacers: [www.ppgpaints.com](http://www.ppgpaints.com).
    - b. Sherwin-Williams: Builders Solution Interior Surfacers A63W00100: [www.sherwin-williams.com](http://www.sherwin-williams.com).
    - c. USG Corporation: USG Sheetrock Brand Tuff-Hide Primer-Surfacers: [www.usg.com](http://www.usg.com).
    - d. Substitutions: Not permitted.
- 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.

## **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.
  1. Level ceiling system to a tolerance of 1/1200.
  2. Laterally brace entire suspension system.
- C. Studs: Space studs at 16 inches on center.
  1. Extend partition framing to structure where indicated and to ceiling in other locations.



2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
  3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
  - E. Standard Wall Furring: Install at concrete and masonry walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
    1. Orientation: Horizontal.
    2. Spacing: As indicated.
  - F. Acoustic Furring: Install resilient channels at maximum 24 inches on center. Locate joints over framing members.
  - G. Furring for Fire Ratings: Install as required for fire resistance ratings indicated and to GA-600 requirements.
  - H. Blocking: Install wood blocking for support of:
    1. Framed openings.
    2. Wall mounted cabinets.
    3. Plumbing fixtures.
    4. Toilet partitions.
    5. Toilet accessories.
    6. Wall mounted door hardware.

### **3.03 ACOUSTIC ACCESSORIES INSTALLATION**

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
  1. Place one bead continuously on substrate before installation of perimeter framing members.
  2. Place continuous bead at perimeter of each layer of gypsum board.
  3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

### **3.04 BOARD INSTALLATION**

- A. Comply with ASTM C840, 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. Double-Layer Non-Rated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board at exterior walls and at other locations as indicated. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.
- D. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- E. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.
- F. 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.
- G. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.

### **3.05 INSTALLATION OF TRIM AND ACCESSORIES**

- A. Control Joints: Place control joints consistent with lines of building spaces and as directed.
  - 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.

### **3.06 JOINT TREATMENT**

- A. Glass Mat Faced Gypsum Board: Use fiberglass joint tape, bedded and finished with chemical hardening type joint compound.
- B. 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.
- C. Finish gypsum board in accordance with levels defined in GA 214-10 and ASTM C840, as follows:
  - 1. Level 5: Walls and ceilings to receive non-textured flat paint, eggshell, satin, semi-gloss or gloss paint finish and other areas specifically indicated.
    - a. Walls and ceilings subject to critical lighting conditions, regardless of finish type, shall receive Level 5 finish.
  - 2. Level 4: Walls and ceilings to receive textured flat paint finish or wall coverings, unless otherwise indicated.
  - 3. Level 3: Walls to receive medium or heavy textured wall finish.
  - 4. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
  - 5. Level 0: Temporary partitions.
- D. 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 base layer of double layer applications.
- E. 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.
- F. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

### **3.07 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 51 00**  
**ACOUSTICAL CEILINGS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Suspended metal grid ceiling system.
- B. Acoustical units.
- C. Supplementary acoustical insulation above ceiling.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Division 15 Section- Fire-Suppression Sprinkler Systems: Sprinkler heads in ceiling system.
- C. Division 15 Section - Air Outlets and Inlets: Air diffusion devices in ceiling.
- D. Division 16 Section - Lighting Fixtures: Light fixtures in ceiling system.
- E. Division 16 Section - Public Address Systems: Speakers 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.
- E. UL (FRD) - Fire Resistance Directory; current edition.

**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 and acoustical units.
- C. Samples: Submit two samples 12 by 12 inches in size illustrating material and finish of acoustical units.
- D. Samples: Submit two samples each, 12 inches long, of suspension system main runner.
- E. Manufacturer's Installation Instructions: Indicate special procedures.

**1.06 QUALITY ASSURANCE**

- A. Fire-Resistive Assemblies: Complete assembly listed and classified by UL (FRD) for the fire resistance indicated.
- B. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. 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.

## 1.08 PROJECT CONDITIONS

- 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. Install acoustical units after interior wet work is dry.

## PART 2 PRODUCTS

### 2.01 ACOUSTICAL UNITS

- A. Manufacturers:
  - 1. Supply acoustical panels from manufacturers listed in the Finish Schedule located on the Drawings.
  - 2. Substitutions: Not permitted.
- B. Acoustical Units - General: ASTM E1264, Class A.
  - 1. Mounting Method for Measuring Noise Reduction Coefficient: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface per ASTM E 795.
- C. Acoustical Unit Colors and Patterns: Match appearance characteristics indicated for each product type.
  - 1. Where appearance characteristics of acoustical tiles are indicated by referencing ASTM E 1264 pattern designations and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range of products that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.
- D. Antimicrobial Treatment: Provide acoustical tiles treated with manufacturer's standard antimicrobial solution consisting of a synergistic blend of substituted ammonium salts of alkylated phosphoric acids admixed with free alkylated phosphoric acid that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria.

### 2.02 SUSPENSION SYSTEM(S)

- A. Manufacturers:
  - 1. Armstrong World Industries, Inc: [www.armstrong.com](http://www.armstrong.com).
  - 2. Chicago Metallic Corporation, a subsidiary of Saint-Gobain: [www.chicagometallic.com](http://www.chicagometallic.com).
  - 3. USG: [www.usg.com](http://www.usg.com).
  - 4. Substitutions: Not permitted.
- B. 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.
- C. Exposed Steel Suspension System: 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. Finish: White painted.
- D. Accessories:
  - 1. Support Channels and Hangers: Galvanized steel; size and type as necessary to suit application, seismic requirements, and ceiling system flatness requirement specified.
  - 2. Perimeter Moldings: Same material and finish as grid.
    - a. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.
  - 3. Gypsum Board: Fire rated type; 5/8 inch thick, ends and edges square, paper faced.
  - 4. Acoustical Sealant For Perimeter Moldings: Non-hardening, non-skinning, for use in conjunction with suspended ceiling system.
  - 5. Gasket For Perimeter Moldings: Closed cell rubber sponge tape.

6. 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. Locate system on room axis according to reflected plan.
- D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
- E. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.
- F. 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.
- G. 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.
- H. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- I. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- J. Do not eccentrically load system or induce rotation of runners.
- K. 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.
- L. Install light fixture boxes constructed of gypsum board above light fixtures in accordance with fire rated assembly requirements and light fixture ventilation requirements.

#### **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. Lay directional patterned units with pattern parallel to longest room axis, unless otherwise indicated.
- D. Fit border trim neatly against abutting surfaces.
- E. Install units after above-ceiling work is complete.
- F. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- G. Cutting Acoustical Units:
  1. Cut to fit irregular grid and perimeter edge trim.
  2. Make field cut edges of same profile as factory edges.
  3. Double cut and field paint exposed reveal edges.
- H. Where round obstructions occur, provide preformed closures to match perimeter molding.
- I. For fire-rated ceiling assemblies, install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating requirements.

J. Install hold-down clips on all 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.

**3.05 SCHEDULE**

A. See Finish Schedule on Drawings for acoustical panel pattern and color.

**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 54 00 - Cast Underlayment.

**1.03 REFERENCE STANDARDS**

- A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2014c.
- B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
- C. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2004 (Reapproved 2014).
- D. ASTM F1861 - Standard Specification for Resilient Wall Base; 2008 (Reapproved 2012).
- E. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2015.

**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, 6 x 6 inches in size illustrating color and pattern for each resilient flooring product scheduled, specified, or otherwise selected.
- 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.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Protect roll materials from damage by storing on end.
- D. Do not double stack pallets.

**1.06 FIELD CONDITIONS**

- A. 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 SHEET FLOORING**

**2.02 TILE FLOORING**

- A. Vinyl Composition Tile: Homogeneous, with color extending throughout thickness.
  - 1. Manufacturers:

- a. As scheduled or otherwise indicated on the drawings, or if not indicated, as selected by the Architect.
  - b. Substitutions: Not permitted.
- 2. Minimum Requirements: Comply with ASTM F1066, of Class corresponding to type specified.
- 3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
- 4. Size: 12 by 12 inch.
- 5. VOC Content Limits: As specified in Section 01 61 16.
- 6. Thickness: 0.125 inch.
- 7. Patterns and Colors: As scheduled or otherwise indicated on the drawings, or if not indicated, as selected by the Architect.

### **2.03 RESILIENT BASE**

- A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.
  - 1. Manufacturers:
    - a. As scheduled or otherwise indicated on the drawings, or if not indicated, as selected by Architect.
    - b. Substitutions: Not permitted.
  - 2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
  - 3. Thickness: 0.125 inch thick.
  - 4. Finish: Matte.
  - 5. Length: Roll.
  - 6. Height(s), and Type(s): As scheduled or otherwise indicated on the drawings, or if not indicated, as selected by Architect.
  - 7. Accessories: Premolded external corners and internal corners.

### **2.04 ACCESSORIES**

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
- C. Moldings, Transition and Edge Strips: As indicated in the Drawings, or if not indicated, aluminum strips suitable for each edge or transition condition..
- D. Sealer and Wax: Types recommended by flooring manufacturer.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks and other irregularities 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.
- D. Verify that required floor-mounted utilities are in correct location.

### **3.02 PREPARATION**

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



- B. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.
- C. Prohibit traffic until filler is fully cured.
- D. Clean substrate.
- E. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

### **3.03 INSTALLATION - GENERAL**

- 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.
  - 1. Metal Strips: Attach to substrate before installation of flooring using stainless steel screws.
- H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
- I. Install flooring in recessed floor access covers, maintaining floor pattern.
- J. At movable partitions, install flooring under partitions without interrupting floor pattern.
- K. Install feature strips where indicated.

### **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 tile pattern.
- C. Install tile to pattern indicated in the Drawings, or if not indicated, basket weave pattern. Allow minimum 1/2 full size tile width at room or area perimeter.

### **3.05 INSTALLATION - RESILIENT BASE**

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 60 inches between joints.
- B. Miter internal corners. At external corners, use premolded units. 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.
- C. Seal and wax resilient flooring products in accordance with manufacturer's instructions.

### **3.07 PROTECTION**

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

**END OF SECTION**

**SECTION 09 67 00**  
**FLUID-APPLIED FLOORING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Fluid-applied flooring and base.

**1.02 REFERENCE STANDARDS**

**1.03 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 and colors available.
- C. Samples: Submit two samples, 6 by 6 inch in size illustrating color and pattern for each floor material for each color specified.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Fluid-Applied Flooring: Epoxy base coat(s) with embedded quartz aggregate.
  - 1. Top Coat: Polyurethane.
  - 2. Color: As selected by Architect.
  - 3. Products:
    - a. Basis of Design: Stonhard; Stonblend GSI.
    - b. Substitutions: See Section 01 60 00 - Product Requirements.

**2.02 ACCESSORIES**

- A. Base Caps, and Separator Strips: Match divider strips, with projecting base of 1/8 inch.
- B. Cant Strips: Molded material compatible with flooring.
- C. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.
- D. Primers and Adhesives: Waterproof; types recommended by flooring manufacturer.

**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 flooring.
- 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 flooring.

**3.02 PREPARATION**

- A. Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with sub-floor filler.
- B. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Grind irregularities above the surface level. Prohibit traffic until filler is cured.
- C. Apply primer to surfaces required by flooring manufacturer.

**3.03 INSTALLATION - FLOORING**

- A. Apply in accordance with manufacturer's instructions.
- B. Apply each coat to minimum thickness indicated.
- C. Finish to smooth level surface.
- D. Cove at vertical surfaces.

**3.04 PROTECTION**

- A. Barricade area to protect flooring until fully cured.

**END OF SECTION**

**SECTION 09 91 23**  
**INTERIOR PAINTING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Surface preparation.
- B. Field application of paints, stains, and varnishes.
- C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
  - 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
  - 2. Prime surfaces to receive wall coverings.
  - 3. Mechanical and Electrical:
    - a. Where visible by persons in finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment with one coat of flat black paint, unless otherwise indicated.
    - b. In finished areas, paint shop-primed items.
    - c. Paint interior surfaces of air ducts and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
- D. Do Not Paint or Finish the Following Items:
  - 1. Items factory-finished unless otherwise 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, bar code labels, and operating parts of equipment.
  - 5. Stainless steel, anodized aluminum, bronze, terne coated stainless steel, and lead items.
  - 6. Marble, granite, slate, and other natural stones.
  - 7. Floors, unless specifically indicated to be painted.
  - 8. Ceramic and other tiles.
  - 9. Brick, architectural concrete, cast stone, integrally colored plaster and stucco.
  - 10. Glass and similar integrally-finished glazing materials.
  - 11. Acoustical materials, unless specifically indicated.
  - 12. Concealed pipes, ducts, and conduits.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 22 05 53 - Identification for Plumbing Piping and Equipment: Painted identification.
- C. Section 23 05 53 - Identification for HVAC Piping and Equipment: Painted identification.

**1.03 DEFINITIONS**

- A. Conform to ASTM D16 for interpretation of terms used in this section.
- B. Gloss (Sheen) Levels: As defined by the Master Painters Institute (MPI).

**1.04 REFERENCE STANDARDS**

- A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2014.
- B. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating; 2005 (Reapproved 2012).
- C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials; 2007.

- D. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials; 2015.
- E. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; current edition, www.paintinfo.com.
- F. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition, www.paintinfo.com.
- G. SSPC-SP 1 - Solvent Cleaning; 2015.
- H. SSPC-SP 6 - Commercial Blast Cleaning; 2007.
- I. SSPC-SP 13 - Surface Preparation of Concrete; (Reaffirmed 2015); 2003.

#### **1.05 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of 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.
  - 4. If proposal of substitutions is allowed under submittal procedures, explanation of substitutions proposed.
- C. Samples for Verification: Submit three paper "draw down" samples on cards at least 8-1/2 by 11 inches in size, illustrating actual color and gloss level for each finishing product scheduled and specified.
  - 1. Where gloss or sheen is specified, submit samples in only that sheen.
  - 2. Where gloss or sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens definitely not required.
  - 3. Allow 30 days for approval process, after receipt of complete samples by Architect.
  - 4. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as masonry, have been approved.
- D. Certification: By manufacturer that paints and finishes comply with VOC limits specified.
- E. Manufacturer's Instructions: Indicate special surface preparation procedures and substrate conditions requiring special attention.
- F. 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 finished surfaces, and samples of each color and gloss level used.
- 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.
  - 2. Extra Paint and Finish Materials: 1 gallon of each coating color, type, surface texture, and gloss level; from the same product run, 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 three years experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years experience and approved by manufacturer.

#### **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 and sheen 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 materials when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F above the dew point; or to damp or wet surfaces.
- D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.
- E. Minimum Application Temperature for Varnish Finishes: 65 degrees F for interior, 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 paints and finishes from the same manufacturer to the greatest extent possible.
  - 1. In the event that a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
- B. Paints:
  - 1. Behr Process Corporation: [www.behr.com](http://www.behr.com).
  - 2. PPG Paints: [www.ppgpaints.com](http://www.ppgpaints.com).
  - 3. Sherwin-Williams Company: [www.sherwin-williams.com](http://www.sherwin-williams.com).
- C. Transparent Finishes:
  - 1. Behr Process Corporation: [www.behr.com](http://www.behr.com).
  - 2. PPG Paints Deft Interior Clears/Polyurethanes: [www.ppgpaints.com](http://www.ppgpaints.com).
  - 3. Sherwin-Williams Company: [www.sherwin-williams.com](http://www.sherwin-williams.com).
- D. Primers and Primer Sealers: Same manufacturer as top coats. Use primers recommended by the manufacturer for the top coat used.
- E. Substitutions: Not permitted.

### **2.02 PAINTS AND FINISHES - GENERAL**

- A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.
  - 1. Where MPI paint numbers are specified, for each type of substrate and condition, provide one of the products listed in Master Painters Institute Approved Product List, current edition available at [www.paintinfo.com](http://www.paintinfo.com), for the specified MPI categories, except as otherwise indicated. Where particular manufacturers and products are specified within each MPI paint number category, provide only one of those specified products, or, if substitutions are allowed, a substitution approved by the Architect.
  - 2. Provide paints and finishes 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 paint material in quantity required to complete entire project's work from a single production run.
  5. Reduce, thin, and dilute paints or finishes, and add materials, only if such procedures are specifically allowed and described in the manufacturer's product instructions, and only as recommended in those instructions.
- B. Flammability: Comply with applicable code for surface burning characteristics.
- C. Sheens: Provide the sheens specified or otherwise indicated. Where sheen is not indicated, provide MPI Gloss Level 3 ("egg-shell-like") unless otherwise directed by Architect.
- D. Colors: As indicated on drawings, or as specified or otherwise selected by Architect.
1. \_\_\_\_\_, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.

### 2.03 PAINT SYSTEMS - INTERIOR

- A. Paint I-OP (Interior, Opaque, MPI Gloss Level 3, "egg-shell-like") - Interior Vertical Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, wood, and plaster.
1. Two top coats and one coat primer.
  2. Top Coat(s): Interior Latex; MPI #52 (MPI GL3).
    - a. Products:
      - 1) Behr Premium Plus Interior Eggshell Enamel [No. 2050]. (MPI #52)
      - 2) Benjamin Moore Ultra Spec 500 Waterborne Interior Eggshell N538/K538 (MPI #52)
      - 3) PPG Paints Speedhide Zero Interior Zero VOC Latex Satin 6-4410XI. (MPI #52)
      - 4) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Eg-Shel. (MPI #52)
      - 5) Valspar Emblem Interior Latex, No. 54530 Series, Semi-Gloss. (MPI #54)
      - 6) Substitutions: Not permitted.
  3. Top Coat Sheen:
    - a. Eggshell: MPI gloss level 3; typical except where otherwise specified or indicated; use this sheen at all locations except ceilings, soffits, exposed overhead structural and MEP system components, and other overhead surfaces.
  4. Primer: As recommended by top coat manufacturer for specific substrate.
- B. Paint I-OP-MD-DT - Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals and wood, MPI Gloss Level 5 (Semi-gloss):
1. Medium duty applications include doors, door frames, railings, handrails, guardrails, balustrades, and exposed columns, and elsewhere if and as scheduled or otherwise indicated on the drawings.
  2. Two top coats and one coat primer.
  3. Top Coat(s): Interior Light Industrial Coating, Water Based; MPI #153 (MPI GL Semi-Gloss).
    - a. Products:
      - 1) Behr Direct to Metal Interior Exterior DTM Semi Gloss White Base 3200 (MPI# 153)
      - 2) Benjamin Moore Super Spec HP DTM Acrylic Semi-Gloss HP29/FP29. (MPI# 153)
      - 3) PPG Paints Pitt-Tech Plus WB DTM Industrial Enamel, 90-1210 Series, Semi-Gloss. (MPI #153)
      - 4) Sherwin-Williams Pro Industrial Acrylic Coating, Semi-Gloss. (MPI #153)
      - 5) Substitutions: Not permitted.
  4. Top Coat Sheen:
    - a. Semi-Gloss: MPI gloss level 5 at all locations.
  5. Primer: As recommended by top coat manufacturer for specific substrate.
- C. Paint I-OP-DF - Dry Fall: Overhead metals; exposed structure and overhead-mounted services in utilitarian spaces, including but not necessarily limited to 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 or black, as scheduled, or if not scheduled, as selected by Architect for the application.
  3. Top Coat: Latex Dry Fall; MPI #118 (MPI Gloss Level 1, Flat).
    - a. Products:
      - 1) Behr PRO Dryfall White PR890 (or Black PR891). (MPI #118)
      - 2) Benjamin Moore Coronado Super Kote 5000 Dry Fall Acrylic Latex Flat N110. (MPI #118)
      - 3) PPG Paints Speedhide Super Tech Water Based Interior Dry-Fog, 6-725XI, Flat. (MPI #118)
      - 4) Sherwin-Williams Waterborne Acrylic Dryfall, Flat. (MPI #118)
      - 5) Substitutions: Not permitted.
  4. Top Coat Sheen:
    - a. Flat: MPI gloss level 1, Flat.
  5. Primer: As recommended by top coat manufacturer for specific substrate.
- D. Paint I-TR -W - Transparent Finish on Wood.
1. 2 top coats over sanding sealer, no stain.
  2. Top Coat(s): Clear Water Based Varnish; MPI #128, 129, or 130.
    - a. Products:
      - 1) PPG Paints Deft Interior Polyurethane WB Acrylic Satin, DFT 159.
      - 2) Sherwin-Williams Wood Classics Waterborne Polyurethane Varnish, Satin.

#### 2.04 PRIMERS

- A. Primers: Provide the following wherever appropriate to the substrate and top coat unless another primer is required or recommended by manufacturer of top coats.
1. Alkali Resistant Water Based Primer; MPI #3.
    - a. Application: Concrete, Portland cement plaster, clay masonry (brick, tile).
    - b. Products:
      - 1) Behr Concrete and Masonry Bonding Primer [No. 880].
      - 2) Behr Premium Plus Interior/Exterior Multi-Surface Primer and Sealer [No. 436]. (MPI #3)
      - 3) Benjamin Moore Super Spec Int/Ext High-Build Masonry Primer NO68 (MPI #3).
      - 4) PPG Seal Grip Acrylic Universal Primer/Sealer 17-921 Series (MPI #3).
      - 5) PPG Perma-Crete Int/Ext Alkali Resistant Primer 4-603 (MPI #3).
      - 6) Sherwin-Williams Loxon Concrete & Masonry Primer A24W8300 (MPI #3).
      - 7) Sherwin-Williams PrepRite ProBlock Int/Ext Latex Primer/Sealer B51W00620 (MPI #3).
      - 8) Substitutions: Not permitted.
  2. Interior Institutional Low Odor/VOC Primer Sealer[White Pigmented]; MPI #149 or MPI #149 X-Green.
    - a. Application: New gypsum board, interior plaster and concrete to be finished with latex finish coats.
    - b. Products:
      - 1) Behr Premium Plus Interior All-In-One Primer 75. (MPI #149, #149 X-Green)
      - 2) Benjamin Moore Eco-Spec WB Interior Latex Primer N372/F372 (MPI #149, #149 X-Green).
      - 3) Benjamin Moore Ultra-Spec 500 Waterborne Interior Primer N534/K534 (MPI #149, #149 X-Green).
      - 4) PPG Pittsburgh Wonder-Pure No VOC Interior Primer DRP3160 (MPI #149)
      - 5) PPG Paints Speedhide Zero Interior Zero VOC Latex Sealer, 6-4900XI (MPI #149, #149 X-Green).
      - 6) Sherwin-Williams ProMar 200 Zero Interior Latex Primer B28W02600/B28WQ2600 (MPI #149, #149 X-Green).
      - 7) Sherwin-Williams ProMar 200 Zero Interior Latex Primer B28W02600 (MPI #149).
      - 8) Substitutions: Not permitted.



3. Interior/Exterior Latex Block Filler; MPI #4 or MPI #4 X-Green.
  - a. Application: Concrete masonry units (CMU, i.e. concrete block, concrete brick).
  - b. Products:
    - 1) Behr Pro Block Filler PR50. (MPI #4, MPI #4 X-Green)
    - 2) Benjamin Moore Coronado Super Kote 5000 Latex Production Block Filler Flat 958 (MPI #4, #4 X-Green).
    - 3) Benjamin Moore Super Spec Int/Ext High-Build Block Filler206/K206 (MPI #4, #4 X-Green).
    - 4) PPG Paints Concrete Coatings Block Filler Interior/Exterior Primer 3010 (MPI #4 X-Green).
    - 5) Sherwin-Williams PrepRite Int/Ext Block Filler B25W00025/B25WQ8025 (MPI #4, #4 X-Green).
    - 6) Sherwin-Williams Protective & Marine Heavy Duty Block Filler B42W00046 (MPI #4, #4 X-Green).
    - 7) Substitutions: Not permitted.
4. Interior Latex Primer Sealer; MPI #50, #50 X-Green).
  - a. Products:
    - 1) Behr Premium Plus Interior All-In-One Primer and Sealer 75. (MPI #50, #50 X-Green)
    - 2) Benjamin Moore Ultra Spec 500 Waterborne Interior Primer Sealer N534/K534. (MPI #50, #50 X-Green)
    - 3) PPG Paints Speedhide Zero Interior Latex Sealer, 6-4900XI. (MPI #50, #50 X-Green)
    - 4) Sherwin-Williams ProMar 200 Zero Interior Latex Primer B28W02600/B28WQ2600. (MPI #50, #50 X-Green)
    - 5) Substitutions: Not permitted.
5. Anti-Corrosive Alkyd Primer for Metal; MPI #79.
  - a. Application: Field priming of ferrous metals in industrial or light marine environments, for both latex and alkyd finish coats. Minimum surface preparation for new work is SSPC SP6 commercial blast cleaning.
  - b. Products:
    - 1) Benjamin Moore Super Spec HP Alkyd Metal Primer P06/KP06 (MPI #79).
    - 2) Benjamin Moore Super Spec HP DTM Alkyd Low Lustre P23/KP23 (MPI #79).
    - 3) PPG Devco Coatings Devguard 4160 (MPI #79).
    - 4) PPG Paints Speedhide Int/Ext Rust Inhibitive Steel Primers 6-212 (MPI #79).
    - 5) Sherwin-Williams Protective & Marine Kem Bond HS B50WZ4 (MPI #79).
    - 6) Sherwin-Williams Protective & Marine Kem Kromik Universal Primer B50WZ1 (MPI #79).
6. Interior Rust-Inhibitive Water Based Primer; MPI #107.
  - a. Products:
    - 1) Behr Premium Plus Interior/Exterior Multi-Surface Primer and Sealer 436. (MPI #107)
    - 2) PPG Paints Pitt-Tech Plus DTM Industrial Primer 90-912.
    - 3) Sherwin-Williams Pro Industrial ProCryl Universal Primer B66W310. (MPI #107)
    - 4) Substitutions: Not permitted.
7. Interior Water Based Primer for Galvanized Metal; MPI #134.
  - a. Application: Galvanized ferrous metal.
  - b. Products:
    - 1) Behr Premium Plus Interior/Exterior Multi-Surface Primer and Sealer 436. (MPI #134)
    - 2) Benjamin Moore Ultra Spec HP Acrylic Metal Primer HP04/FP04. (MPI# 134)
    - 3) PPG Paints Pitt-Tech Plus DTM Industrial Primer 90-912.
    - 4) PPG Corrostop ULtra Metal Primer, Latex Base for rust free galvanized metal, white 635-045 (MPI #134)
    - 5) Sherwin-Williams Pro Industrial ProCryl Universal Primer B66W310. (MPI #134)

- 6) Sherwin-Williams Protective & Marine DTM Acrylic Primer/Finish B66W1. (MPI #134)
- 7) Substitutions: Not permitted.
8. Stain Blocking Primer, Water Based; MPI #137, #137 X-Green.
  - a. Products:
    - 1) Behr Premium Plus Interior All-In-One Primer 75.
    - 2) Benjamin Moore Sure Seal Latex Primer Sealer 027/K027. (MPI#137, #137 X-Green)
    - 3) PPG Paints Seal Grip Int/Ext Acrylic Universal Primer/Sealer, 17-921. (MPI #137)
    - 4) Sherwin-Williams Multi-Purpose Latex Primer/Sealer B51W00450. (MPI#137, #137 X-Green)
    - 5) Substitutions: Not permitted.
9. Bonding Primer, Water Based; MPI #17.
  - a. Application: Where necessary for adequate adhesion to slick, non-porous substrates, including glass, plastic, fiberglass, PVDF (Kynar) finishes, and glazed brick, stone and tile.
  - b. Products:
    - 1) Behr Premium Plus Int/Ext Multi-Surface Primer 436. (MPI #79)
    - 2) Benjamin Moore Fresh Start High Hiding All Purpose Primer 046/K046 (MPI #17).
    - 3) Benjamin Moore Fresh Start Multi-Purpose Latex Primer N023/F023 (MPI #17).
    - 4) PPG Paints Gripper Int/Ext Primer and Sealer 3210G (MPI #17).
    - 5) PPG Paints Seal Grip Int/Ext Acrylic Universal Primer/Sealer 17-921. (MPI #17)
    - 6) PPG Pittsburgh Killstain WB Int/Ext Latex Primer DRP5180X (MPI #17).
    - 7) Sherwin Williams Extreme Bond Int/Ext Bonding Primer B51W00150 (MPI #17).
    - 8) Sherwin Williams Multi-Purpose Latex Primer/Sealer B51W00450 (MPI #17).
    - 9) Sherwin Williams PrepRite ProBlock Int/Ext Latex Primer/Sealer B51W00620 (MPI #17).
    - 10) Substitutions: Not permitted.

## **2.05 ACCESSORY MATERIALS**

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Do not begin application of paints and finishes 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 effect 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. Plaster and Stucco: 12 percent.
  3. Masonry, Concrete, and Concrete Masonry Units : 12 percent.
  4. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

### 3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to 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 paints or finishes 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:
  - 1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
  - 2. Clean surfaces with pressurized water. Use pressure range of 1500 to 4000 psi at 6 to 12 inches. Allow to dry.
  - 3. Clean concrete according to ASTM D4258. Allow to dry.
  - 4. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.
- H. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- I. Plaster: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- J. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
- K. Galvanized Surfaces:
  - 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
- L. Ferrous Metal:
  - 1. Solvent clean according to SSPC-SP 1.
  - 2. Shop-Primed Surfaces: 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.
  - 3. Remove rust, loose mill scale, and other foreign substances using using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.
- M. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.
- N. Wood Surfaces to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.
- O. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.
- P. 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 written instructions and recommendations in "MPI Architectural Painting Specification Manual".

- 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 in thicknesses specified by manufacturer.
- F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.
- G. Sand wood and 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. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.
- J. 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 finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

#### **3.07 SCHEDULE - PAINT SYSTEMS**

- A. Provide the paint systems and sheens specified for the substrates to be painted, in colors that match those indicated in Finish Schedules on the drawings.

**END OF SECTION**

**SECTION 12 35 53.13**  
**METAL LABORATORY CASEWORK**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Metal cabinets and cabinet hardware.
- B. Countertops.

**1.02 RELATED REQUIREMENTS**

- A. Section 12 36 00 - Countertops: Additional requirements for countertops.

**1.03 REFERENCE STANDARDS**

- A. 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.
- B. SEFA 2.3 - Installation of Scientific Laboratory Furniture and Equipment; 2010.
- C. SEFA 3 - Work Surfaces; 2010.
- D. SEFA 7 - Laboratory and Hospital Fixtures; 2010.
- E. SEFA 8M - Laboratory Grade Metal Casework; 2010.

**1.04 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Casework locations, large scale plans, elevations, cross sections, rough-in and anchor placement dimensions and tolerances, clearances required, and utility locations, if any.

**1.05 QUALITY ASSURANCE**

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Metal Laboratory Casework:
  - 1. Kewaunee Scientific Corp: [www.kewaunee.com](http://www.kewaunee.com).
  - 2. Mott Manufacturing: [www.mott.ca](http://www.mott.ca).
  - 3. Substitutions: Not permitted.

**2.02 METAL LABORATORY CASEWORK**

- A. Casework: Die-formed metal sheet; each unit self-contained and not dependent on adjacent units or building structure for rigidity; factory-fabricated, factory-assembled, and factory-finished.
  - 1. Style: Flush overlay.
  - 2. Steel Sheet Metal:
    - a. Gables, Front and Back Panels, Gusset Plates and Rails: 18 gage, 0.0478 inch minimum thickness.
    - b. Drawers, Cabinet Floors, Shelves, Filler Panels and Drawer Dividers: 20 gage, 0.0359 inch minimum thickness.
    - c. Backing Sheet to Door and Door Fronts: 22 gage, 0.0299 inch minimum thickness.
  - 3. Structural Performance: In addition to the requirements of SEFA 3, SEFA 7 and SEFA 8M, provide components that safely support the following minimum loads, without deformation or damage:
    - a. Base Units: 500 lbs/linear ft across the cabinet ends.
    - b. Suspended Units: 300 lbs, minimum, static load.
    - c. Tables: 300 lbs on four legs.
    - d. Drawers: 125 lbs.
    - e. Hanging Wall Cases: 300 lbs.
    - f. Shelves: 100 lbs.

4. Corners and Joints: Without gaps or inaccessible spaces or areas where dirt or moisture could accumulate.
  5. Edges and Seams: Smooth. Form counter tops, shelves, and drain boards from continuous sheets.
  6. Shelf Edges: Turn down 1 inch on each side and return 5/8 inch front and back.
  7. Ends: Close open ends with matching construction.
  8. Welding: Electric spot weld; grind joints smooth and flush.
  9. Drawers and Doors: Fabricate drawer and door fronts of sandwiched sheets of sheet steel welded together and reinforced for hardware. Fill with sound deadening core.
  10. Finish on Sheet Steel: Provide surface finish having chemical resistance equal to Level 0 (no change) or Level 1 (slight change of gloss or slight discoloration) according to SEFA 8M.
    - a. Coating Type: Baked on epoxy; minimum two coats.
    - b. Color: As selected from manufacturer's standard selection.
    - c. Preparation: Degrease and phosphate etch, and prime.
  11. Stainless Steel Finish: No. 4, brushed finish.
  12. Separation: Use bituminous paint or non-conductive tape to coat metal surfaces in contact with cementitious materials and to separate dissimilar metals.
- B. Countertops: As specified in Section 12 36 00.
1. Backing: Pressure glued to plywood core backing, without visible joints.

## **2.03 MATERIALS**

- A. Sheet Steel: High-strength low-alloy, cold rolled and leveled unfinished steel sheet, ASTM A1008/A1008M, Class 1 (matte) finish.
- B. Cabinet Hardware: Manufacturer's standard styles, exposed components stainless steel.
  1. Finish of Exposed Components: No. 4 finish.
  2. Shelves:
    - a. Shelf Standards and Rests: Vertical chrome steel standards with rubber button fitted steel rests.
    - b. Shelf Brackets: Vertical chrome steel standards with chrome steel arms.
  3. Swinging Doors:
    - a. Hinges: Offset pin.
    - b. Catches: Magnetic.
    - c. Pulls: Chrome wire pulls, 4 inches wide.
  4. Drawers:
    - a. Pulls: Chrome wire pulls, 4 inches wide.
    - b. Slides: Steel, full extension arms, ball bearings; capacity as recommended by manufacturer for drawer height and width.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Perform installation in accordance with manufacturer's instructions and with SEFA 2.3.
- B. Use anchoring devices to suit conditions and substrate materials encountered.
- C. Set casework items plumb and square, securely anchored to building structure.
- D. Align cabinets to adjoining components, install filler panels where necessary to close gaps.
- E. Separate dissimilar metals to prevent galvanic action.
- F. Replace units that are damaged, including those that have damaged finishes.

**END OF SECTION**

**SECTION 12 36 00**  
**COUNTERTOPS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Countertops for architectural cabinet work.
- B. Countertops for manufactured casework.
- C. Wall-hung counters.

**1.02 RELATED REQUIREMENTS**

- A. Section 06 41 00 - Architectural Wood Casework.
- B. Section 12 31 00 - Manufactured Metal Casework.

**1.03 REFERENCE STANDARDS**

- A. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2014.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- C. AWI (QCP) - Quality Certification Program; current edition at [www.awiqcp.org](http://www.awiqcp.org).
- D. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- E. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.
- F. IAPMO Z124 - Plastic Plumbing Fixtures; 2012.
- G. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
- H. ISFA 3-01 - Classification and Standards for Quartz Surfacing Material; 2013.
- I. MIA (DSDM) - Dimensional Stone Design Manual; VII, 2007.
- J. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- K. PS 1 - Structural Plywood; 2009.

**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. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.
- E. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns.
- F. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
- G. Installation Instructions: Manufacturer's installation instructions and recommendations.
- H. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

**1.05 QUALITY ASSURANCE**

- A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

- B. Quality Certification: Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section.
  1. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
  2. Provide designated labels on shop drawings as required by certification program.
  3. Provide designated labels on installed products as required by certification program.
  4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

#### **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 COUNTERTOPS**

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Epoxy Resin Countertops: Filled epoxy resin molded into homogenous, non-porous sheets; no surface coating and color and pattern consistent throughout thickness; with integral or adhesively seamed components.
  1. Manufacturers:
    - a. Basis of Design - Manufacturer(s) indicated in the Finish Materials Schedule in the Drawings, or if not indicated, any manufacturer listed here.
    - b. Durcon, Inc.: [www.durcon.com](http://www.durcon.com).
    - c. Prime Industries, Inc.: [www.piilab.com](http://www.piilab.com).
    - d. Substitutions: Not permitted.
  2. Flat Surface Thickness: 1 inch, nominal.
  3. Flammability: Self-extinguishing, when tested in accordance with ASTM D635.
  4. NSF approved for food contact.
  5. Surface Finish: Smooth, non-glare.
  6. Color: Black.
  7. Typical Exposed Edge Shape: 3/16 inch radius corner.
  8. Exposed Edge Shape in Sink Areas: Built-up marine edge 1/4 inch higher than counter by 1 inch wide.
  9. Back and End Splashes: Same material, same thickness; separate for field attachment.
  10. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Premium Grade.
- C. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
  1. Flat Sheet Thickness: 1/2 inch, minimum.
  2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 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. Manufacturers:
      - 1) Basis of Design - As indicated in the Finish Material Schedule in the Drawings, or if not indicated, any manufacturer listed here.



- 2) Dupont: [www.corian.com](http://www.corian.com).
- 3) Formica Corporation: [www.formica.com](http://www.formica.com).
- 4) Wilsonart: [www.wilsonart.com](http://www.wilsonart.com).
- 5) Substitutions: Not permitted.
- b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
- c. Sinks and Bowls: Integral castings; minimum 3/4 inch wall thickness; comply with IAPMO Z124.
- d. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
- e. Color and Pattern: As indicated in the Finish Material Schedule in the Drawings, or if not indicated, as selected by the Architect from manufacturer's full line.
3. Other Components Thickness: 1/2 inch, minimum.
4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge; use marine edge at sinks.
5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
6. Skirts: As indicated on drawings.
7. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Premium Grade.
- D. Natural Quartz and Resin Composite Countertops: Sheet or slab of natural quartz and plastic resin over continuous substrate.
  1. Flat Sheet Thickness: 3/4 inch, minimum.
  2. Natural Quartz and Resin Composite Sheets, Slabs and Castings: Complying with ISFA 3-01 and NEMA LD 3; orthophthalic 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. Manufacturers:
      - 1) Basis of Design - As indicated in the Finish Material Schedule in the Drawings, or if not indicated, any manufacturer listed here.
      - 2) Silestone by Cosentino: [www.silestoneusa.com](http://www.silestoneusa.com).
      - 3) Dupont: [www.dupont.com](http://www.dupont.com).
      - 4) Wilsonart: [www.wilsonart.com](http://www.wilsonart.com).
      - 5) Substitutions: Not permitted.
    - b. Factory fabricate components to the greatest extent practical in sizes and shapes indicated; comply with the MIA Dimension Stone Design Manual.
    - c. NSF approved for food contact.
    - d. Finish on Exposed Surfaces: Polished.
    - e. Color and Pattern: As indicated in the Finish Material Schedule in the Drawings, or if not indicated, as selected by the Architect from manufacturer's full line.
  3. Other Components Thickness: 3/4 inch, minimum.
  4. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.

## 2.02 MATERIALS

- A. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch thick; join lengths using metal splines.
- B. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
- C. Cove Molding for Top of Splashes: Rubber with semi-gloss finish and T-spline to fit between splash and wall; 1/2 inch by 1/2 inch.
- D. Cove Molding for Top of Splashes: Rubber with semi-gloss finish and T-spline to fit between splash and wall; 1/2 inch by 1/2 inch; color as selected.
- E. Joint Sealant: Mildew-resistant silicone sealant, clear.

## 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 counters to be flush with fronts and ends of cabinets unless indicated otherwise.
  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 epoxy resin countertops using compatible adhesive.
- C. Seal joint between back/end splashes and vertical surfaces.
  1. Where indicated use rubber cove molding.
  2. Where applied cove molding is not indicated use specified sealant.

#### **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 Date of Substantial Completion.

**END OF SECTION**

**SECTION 21 12 00**  
**FIRE PROTECTION SYSTEMS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. The Conditions of the Contract and applicable requirements of Division 1, "General Requirements", and Section 23 00 00, "Mechanical General Provisions", govern this Section.

**1.2 DESCRIPTION OF WORK:**

- A. Work Included: Provide modifications and additions ton the Base Building fire sprinkler system to suit the new tenant buildout.
- B. Types: The types of fire protection systems shall include, but is not limited to, the following:
  - 1. The base building fire protection system consist of a complete system of combination standpipes and a wet-pipe sprinkler system in accordance with NFPA 13 and 14 with the sprinkler system served from the building fire pump and combination standpipes. The existing fire sprinkler system shall be modified as required to suit the new space buildout as specified in Section 21 13 13, "Wet-Pipe Fire Sprinkler System".

- C. Fire Pumps and Combination Standpipe System: The fire pumps and combination standpipes existing.

- D. Pressure Ratings: Base Building fire protection piping systems pressure ratings are as follows:

Location	Working Pressure	Operating Temperatures
Low ..... Ground Floor	150 psig	55°F to 80°F

- E. Basic Materials and Methods: Refer to Section 23 05 29, "Sleeves, Flashing, Supports and Anchors", for additional fire protection piping system requirements.

**1.3 QUALITY ASSURANCE:**

- A. Contractor: The fire protection system modification and expansion shall be designed and installed by a fire protection contractor who is licensed by the State of Texas to perform fire protection work of the type specified for this project. The fire protection contractor shall have a minimum of 5 years of experience in the installation of fire protection work of the type specified for this project.

- B. Applicable Publications: The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

- 1. National Fire Protection Association (NFPA):
  - a. NFPA 13 Standard for the Installation of Sprinkler Systems.
  - b. NFPA 14 Standard for the Installation of Standpipe and Hose System.
  - c. NFPA 20 Standard for the Installation of Centrifugal Fire Pumps.
  - d. NFPA 24 Standard for the Installation of Private Fire Service Mains.
  - e. NFPA 70 National Electrical Code.
- 2. Underwriters' Laboratories, Inc.:

- a. Fire Protection Equipment Directory (Latest Addition).
- 3. Factory Mutual Engineering Corporation (FM):
  - a. Approval Guild (Latest Addition).
- 4. American National Standards Institute (ANSI):
  - a. Z 53 Safety Color Code for Marking Physical Hazards.
  - b. A 14 Safety Requirements for Fixed Ladders.
- 5. Welding: Qualify welding procedures, welders, and operators in accordance with ANSI B31.1, Paragraph 127.5, for shop and job site welding of piping work. Make welded joints on the piping system with continuous welds, without backing rings and with pipe ends beveled before welding. Gas cuts shall be true and free from burned metal. Before welding, surfaces shall be thoroughly cleaned. The piping shall be carefully aligned and no weld metal shall project inside the pipe.
- 6. Comply with requirements of Fire Prevention Office of Texas State Board of Insurance and submit Drawings to that agency for approval.
- 7. Materials shall be installed in accordance with NFPA 13 and NFPA 14. All valves, fittings, hose, and equipment shall be UL or FM-labeled. All necessary points of city connections shall be matched to city equipment.
- 8. All hose threads and coupling types shall conform to local fire department requirements.
- 9. Acceptable Manufacturers: The model numbers listed in the Specifications establish a level of quality and material. The following manufacturers are acceptable subject to compliance with the requirements of these Specifications.
  - a. Fire Protection Valves:
    - 1) Crane Company.
    - 2) Jenkins Bros. Valves.
    - 3) Lunkenheimer.
    - 4) Nibco.
    - 5) Victaulic.
    - 6) Stockham Valves and Fittings.
    - 7) Walworth Company.

**1.4 SUBMITTALS:**

- A. Shop drawing submittals shall include, but not be limited to, the following:
  - 1. Cut sheets marked to clearly indicate all fire protection system materials, accessories and manufacturers to be used, including, but not limited to control panels, pipe and fittings, pipe hangers and supports, valves, sprinkler heads, specialties, waterflow switches, valve supervisory switches, and other required materials. This shall include cut sheets on all grooved piping system components and all manufacturers which will be used on the project.
  - 2. Final fire protection system fabrication/shop drawings showing all piping sizes and elevations, sprinkler head types and hydraulic calculations. Piping shall be sized and elevation of mains shall be indicated. Drawings shall be approved by state and local authorities prior to being submitted.
  - 3. Other items as required by Section 23 01 00 and 21 13 13.
  - 4. Additional information as required in Section 23 00 01, Mechanical General Provisions”.

## 1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver fire protection components in factory-fabricated water-resistant wrapping.
- B. Handle fire protection components carefully to avoid damage to components, enclosures, and finish.
- C. Store fire protection components in a clean, dry space and protect from weather.

## PART 2 - PRODUCTS

### 2.1 PIPE AND FITTINGS:

- A. Pipe: Provide pipe and tube of type, joint, grade, size, and weight (wall thickness, schedule or class) indicated for each service. Comply with applicable governing regulations and industry standards.
  - 1. Steel Pipe: Schedule 40, ASTM A53 black or hot-dipped galvanized as specified. All dry and pre-action system piping and fittings shall be externally and internally galvanized. Piping shall be domestically manufactured by one of the manufacturers listed in the latest edition of the American Petroleum Institute (API) approved manufacturers listing.
- B. Fittings: Provide factory-fabricated fittings of type, materials, grade, class, and pressure rating indicated for each service and pipe size. Fittings shall be threaded for 2" and smaller, and schedule 40 steel with grooved fittings for sizes larger than 2". Provide sizes and types matching pipe, tube, valve, and equipment connections. Where not otherwise indicated, comply with governing regulations, industry standards, and where applicable, with pipe manufacturer's instructions for selections.
  - 1. Malleable Iron Threaded Fittings: ANSI B16.3, Class 150 or Class 300, black or galvanized as specified.
  - 2. Malleable Iron Threaded Unions: ANSI B16.39, select for proper piping fabrication and service requirements including style, end connections, and metal-to-metal seats (iron, bronze, or brass), plain or galvanized as specified.
  - 3. Threaded Pipe Plugs: ANSI B16.14.
  - 4. Steel Flanges/Fittings: ANSI B16.5, including bolting, gasketing, and butt weld end connections.
  - 5. Forged Steel Socket-welding and Threaded Fittings: ANSI B16.11, rated to match schedule of connected pipe.
  - 6. Wrought Steel Butt-welding Fittings: ANSI B16.9, except ANSI B16.28 for short radius elbows and returns; rated to match connected pipe.
  - 7. Grooved End Fittings: ASTM A47 or ASTM A536 joined with Victaulic Style 005, 07, 75, or 77 couplings and Grade "E" gaskets.
  - 8. Flanged Fittings: Comply with ANSI B16.15 for bolt-hole dimensioning, materials, and flange-thickness.
  - 9. Flange Bolts: Bolts shall be carbon steel ASTM A307 Grade A hexagon head bolts and hexagonal nuts. Where one or both flanges are cast iron, furnish Grade B bolts. Cap screws utilized with flanged butterfly valves shall be ASTM A307 Grade B with hexagon heads.
  - 10. Flange Bolt Thread Lubricant: Lubricant shall be an antiseize compound designed for temperatures up to 1000°F and shall be Crane Anti-Seize Thread Compound or approved equal.
- C. Miscellaneous Piping Materials/Products:
  - 1. Welding Materials: Comply with ASME Boiler and Pressure Vessels Code, Section II, Part C, for welding materials.
  - 2. Brazing Materials: American Welding Society, AWS A5.B, and Classification BCup-5.

3. Gaskets for Flanged Joints: 1/16" thick for all pipe size 10" and smaller and 1/8" thick for all pipe size 12" and larger. Ring-type shall be used between raised face flanges and full face-type between flat face flanges with punched bolt holes and pipe opening. Gaskets shall be Garlock Style 3400 compressed non-asbestos or equal.
4. Insulating (Dielectric) Unions: Provide dielectric unions at all pipe connections between ferrous and nonferrous piping. Unions shall be "Clearflow" waterway made by Victaulic, "Delvin" as made by Pipeline Seal and Insulator Company or "EPCO" as made by Epco Sales, Inc. and shall have nylon insulation.

**2.2 PIPING FABRICATION/SHOP DRAWINGS:**

- A. Piping fabrication/shop drawings shall be submitted for all fire protection and sprinkler piping and shall indicate new and reused existing pipe size, fittings, valves, accessories, connections, head type, support requirements, pipe elevations and other information required for coordination with other trades and fabrication of piping.

**2.3 PIPE HANGERS AND SUPPORTS:**

- A. Pipe Hangers and Supports: Support fire protection pipe with UL-listed and approved hangers and support devices. Provide any special hangers or supports that may be required. The design, selection, spacing, and application of horizontal and vertical pipe hangers, supports, restraints, anchors, and guides shall be in accordance with the NFPA 13 and NFPA 14. All pipe hangers, rods, supports, inserts and other components shall be galvanized.

**2.4 SLEEVES AND ESCUTCHEONS:**

- A. Pipe passing through walls, floors, and partitions shall be provided with standard weight steel pipe sleeves. Sleeves through walls in finished spaces shall be flush. Where located in the floor construction, the sleeves shall project not less than 2" above the floor line. Refer to Section 23 03 00 for fire stopping and additional sleeve requirements.
- B. Provide escutcheons for pipes passing through walls, partitions, or ceilings. Escutcheons shall be provided where pendant sprinkler heads penetrate ceilings or sidewall heads penetrate walls. Pipe escutcheons shall be chrome-plated steel. Sprinkler escutcheons shall be white-painted or chrome-plated steel as specified. Refer to Section 23 03 00 for additional requirements.

**2.5 VALVES AND ACCESSORIES:**

- A. General: All valves and accessories shall be similar to numbers listed. All similar type and size valves and accessories shall be products of one manufacturer.
- B. Applications: Valve application shall be as follows:

<u>Service</u>	<u>Application</u>	<u>Type</u>
Fire Protection	Shutoff Check	OS&Y Gate, Ball or Butterfly Swing Check

- C. Pressure Ratings:

<u>Service</u>	<u>Location</u>	<u>Rating</u>
Fire Protection	Ground Floor	175 psi

- D. Chain Operators: Chain operators shall be provided for all valves installed over 8' above finished floor in the central plant, fan rooms, mechanical rooms and other areas where valves are exposed.
- E. Flanges: Valve flanges and companion flanges for all valve applications shall be compatible with the valve rating and the system pressure at the point of application. Flanges shall conform to ANSI B16.1 and ANSI B16.10.
- F. General Requirements:
1. All valves shall be of threaded or flanged type. No solder connected valves on water lines shall be used on this project. All bronze and iron body gate and globe valves shall be of one manufacture for each project. Manufacturers of other types may not be mixed on the same project; i.e., all butterfly valves shall be of the same manufacture, all ball valves shall be of the same manufacture, etc.
  2. All valves at system points where the System Working Pressure (SWP) at the point of application, including appropriate pump shutoff head, does not exceed 150 psi, may use Class 150 valves.
  3. All bronze gate valves for pressures up to 150 psi shall be ASTM B62 composition bronze. Bronze valves for pressures above 150 psi shall be ASTM B61 steam bronze. All bronze valves shall be union or screw over bonnet, rising stem type with ASTM 584 alloy 876 or equal stem material.
  4. All bronze ball valves for pressures up to 300 psi shall be ASTM B62 composition bronze.
  5. All iron body valves shall have the pressure containing parts constructed of ASTM A126 Class B cast iron. Stem material shall meet ASTM Alloy 876 or ASTM 371 Alloy 876 silicon bronze or its equivalent. Gates and globes shall be bolted bonnet with OS&Y (outside screw and yoke) and rising stem design. A lubrication fitting shall be provided on yoke cap for maintenance lubrication of the yoke bushing.
  6. All valves shall be repackable, under pressure, with the valve in the full open position.
  7. All gate valves, globe valves, angle valves and shutoff valves of every character shall have malleable iron handwheels, except iron body valves 2-1/2" and larger which may have either malleable iron or ASTM A126 Class B, gray iron handwheels.
  8. Packing for all valves shall be selected for the pressure-temperature service of the valve. It is incumbent upon the manufacturer to select the best quality, standard packing for the intended valve service. At the end of one year period spot checks will be made, and should the packing show signs of hardening or causing stem corrosion then all valves supplied by the manufacturer shall be repacked at no expense to the Owner with a packing material selected by the Owner.
  9. Valves located with stem in horizontal position shall be drilled and tapped in accordance with MSS-SP-45 at Boss G to accommodate a drain valve.
  10. All fire protection valves shall be UL-listed and FM-approved for fire protection use.
- G. Fire Protection Valves For Service at or Less Than 175 PSIG:
1. Gate Valves:
    - a. Gate valves 2" and smaller shall be 175 psi WOG rated, UL-listed, FM-approved, all bronze outside screw and yoke, rising stem valves with solid wedges and threaded connections. Valves shall be:
      - 1) Crane No. 459.
      - 2) Jenkins No. 275-U.
      - 3) Nibco No. T-104-O.

- 4) Stockham No. B 133.
  - 5) Walworth No. 8873.
- b. Valves 2-1/2" and larger shall be flanged bronze mounted, UL-listed, FM-approved iron body, outside screw and yoke, rising stem gate valves with bolted bonnets and solid wedges. Valves shall be rated for 175 psi WOG and shall be:
- 1) Crane No. 467.
  - 2) Jenkins No. 825-A.
  - 3) Nibco No. F-607-OTS.
  - 4) Stockham No. G-634.
  - 5) Walworth No. 8713-F.
2. Ball Valves:
- a. Ball valves shall be two piece with a standard size port 316 stainless steel balls and stems, and reinforced seats and stuffing box rings. All ball valves shall be designed to permit repacking while valve is in line. Valves shall be furnished with blowoutproof stems.
- b. Ball valves 3" and smaller shall be threaded or grooved ductile iron body or bronze ASTM B584 alloy 844 of a standard port design with gear operator and position indicator. Valves shall be rated for 300 psi WOG and shall conform to UL 1091 and FM 1112 and shall be:
- 1) Victaulic Series 727-UNS (unsupervised).
  - 2) Victaulic Series 727-SOD (with double pole, double throw supervisory switch).
  - 3) Nibco No. T-505-4 (unsupervised).
  - 4) Nibco No. T-505-8 (with double pole, double throw supervisory switch).
3. Butterfly Valves:
- a. All butterfly valves shall be full tapped and threaded lug or grooved type, manufacturer certified for bubble-tight, dead end shut off from either direction at design working pressure and temperature. Valves shall have enclosed, self-locking wheel-operated worm gear type, waterproof, factory-lubricated operators and position indicators.
- b. Valves 4" and larger shall be 175 psig with ductile iron lug body, EPDM (EPT) replaceable seat, 316 or 416 stainless steel upper and lower stems (stems shall be positively connected to the valve disc) and EPDM (EPT) stem seals. Valves shall conform to UL 1091 and FM 1112 and shall be:
- 1) Victaulic Series 708-UNS (unsupervised).
  - 2) Victaulic Series 708-SOD (with double pole, double throw supervisory switch).
  - 3) Nibco No. GD1765-4 (unsupervised).
  - 4) Nibco No. GD1765-8 (with double pole, double throw supervisory switch).
  - 5) Grinnell equal.
4. Check Valves:
- a. Check valves 2-1/2" and smaller shall be UL-listed, FM-approved threaded cast iron, bronze-fitted swing check valves with horizontal swing and replaceable discs. Valves shall be rated for 175 psi WOG and shall be:
- 1) Stockham No. B-321.



- b. Check valves 3" and larger shall be UL-listed, FM-approved flanged bronze mounted iron body swing check valves with bolted bonnets and renewable seat and disc, or dual disc spring-loaded stainless steel mounted. Valves shall be rated for 175 psi WOG and shall be:
    - 1) Crane No. 375.
    - 2) Jenkins No. 629.
    - 3) Nibco No. F-908-W.
    - 4) Stockham No. G-939.
    - 5) Walworth No. 8883-F.
    - 6) Victaulic 714.
  - c. All swing check valves shall be installed in vertical piping only. Allow adequate pipe clearance to allow for proper valve operation. Provide Grinnell No. 1686 or equal ball drip where required to allow drainage at check valves.
- H. Test/Drain Valves: Test/drain valves for applications to 300 psi shall be Victaulic Style 718 or equal threaded connection test/drain valve assemblies with ductile iron body, bronze valve assembly, acrylic sight glass and aluminum orifice inserts. Orifice size shall coordinate with sprinkler head sizes, installed on the zone served.
- I. Unions: Provide in lines assembled with screwed and soldered fittings at points of connection to items of equipment and elsewhere as indicated or required to permit proper connections to be made or so that equipment may be removed. Unions shall also be provided in welded lines at the connections to items of equipment, where flanges are not provided.
- 1. Unions in steel lines assembled with screwed fittings shall be malleable iron screwed pattern unions with bronze seats. Unions in copper or brass lines shall be all brass, threaded pattern unions. Where unions are required by the above in steel lines assembled by welding, they shall consist of two mating welding flanges.
  - 2. Dielectric unions shall be used at all junctures of dissimilar metals.
  - 3. Unions in 2" and smaller in ferrous lines shall be Class 300 AAR malleable iron unions with iron to brass seats, and 2-1/2" and larger shall be ground flange unions. Unions in copper lines shall be 125 pounds ground joint brass unions or 150 pounds brass flanges if required by the mating item of equipment. Companion flanges on lines at various items of equipment, machines and pieces of apparatus shall serve as unions to permit removal of the particular items. See particular Specifications for special fittings and pressure.
- J. Flanges: All 125/150 pound and 250/300 pound ANSI flanges shall be weld neck and shall be domestically manufactured, forged carbon steel, conforming to ANSI B16.5 and ASTM A181 Grade I or Grade II or A-105-71 as made by Tube Turn, Hackney or Ladish Company. Slip on flanges will not be acceptable. Each fitting shall be stamped as specified by ANSI B16.9 and, in addition, shall have the laboratory control number stenciled on each fitting for ready reference as to physical properties and chemical composition of the material. Complete test reports may be required for any fitting selected at random. Flanges which have been machined, remarked, painted or otherwise produced domestically from imported forgings or materials will not be acceptable. The flanges shall have the manufacturer's trademark permanently identified in accordance with MSS SP-25. Submit data for firm certifying compliance with these Specifications. Gaskets used shall be ring form, dimensioned to fit accurately within the bolt circle, shall be 1/16" thick, Manville service sheet packing Style 60. Inside diameter shall conform to the nominal pipe size. Bolts used shall be carbon steel bolts with semifinished hexagon nuts of American Standard Heavy dimensions. All-thread rods will not be acceptable for flange bolts. Bolts shall have a tensile strength of 60,000 psi and an elastic limit of 30,000 psi. Flat faced flanges shall be furnished where required to match flanges on pumps, check

valves, strainers, and similar items. Only one manufacturer of weld flanges will be approved for each project.

- K. Gaskets: Gaskets shall be placed between the flanges of all flange joints. Such gaskets shall be ring form gaskets fitting within the bolt circle of their respective flanges. Gaskets shall be 1/16" thick Manville Service Sheet Packing Style 60. The inside diameter of such gaskets shall conform to the nominal pipe size and the outside diameter shall be such that the gasket extends outward to the studs or bolts employed in the flanged joint.

## 2.6 FIRE PROTECTION SPECIALTIES:

- A. Water Flow Switches: Viking Model C-1 or equal water flow switch with adjustable retard feature. Switch shall be double-pole double-throw type and shall be rated at least 7 amperes at 125/250 volts.
- B. Valve Supervisory Switches: Potter Electric Signal Company Model OSYS-U or equal. Switches shall activate within two turns of the valve.
- C. Sight Flow Connection: Provide acrylic sight flow connection in all test lines.
- D. Pressure Gauges: Potter-Roemer Fig. No. 6240 or equal 3-1/2" diameter polished brass case, 1/4" NPT male connection, glass enclosed, 0-300 psi dial pressure gauges with isolation valves.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF FIRE PROTECTION PIPING SYSTEMS:

- A. General: All piping system materials, components and installation shall be in accordance with NFPA 13, the City of Houston Building Code and the requirements of the Texas State Board of Insurance.
  1. Standpipe, riser and main piping shall be Schedule 40 black steel pipe (6" or smaller) or Schedule 30 black steel pipe (8" or larger). Thinwall, chlorinated polyvinyl chloride (CPVC) and copper piping shall not be used.
  2. Sprinkler system piping shall in general be as specified hereinabove for fire standpipe piping.
  3. Fittings 2-1/2" and smaller for Schedule 40 pipe shall be malleable iron threaded fittings.
  4. Fittings for piping 3" and larger shall be standard welded fittings or shall be a UL-listed grooved piping connection system with "rolled-grooves". Couplings for standpipes shall be Victaulic Style 07 Zero-Flex couplings with Grade "E" gaskets (no substitute) or Gruvlok Fig. 7000 couplings with Grade "E" gaskets and proper support at the bottom, top and every other intermediate floor as required to prevent vertical up and down movement of the standpipe in accordance with NFPA 13 and NFPA 14. Couplings for piping connections to pumps and their associated valves, to wall mounted Siamese connections, to roof manifolds shall be Victaulic Style 07 Zero-Flex couplings with Grade "E" gaskets (no substitute) or Gruvlok Fig. 7000 couplings with Grade "E" gaskets and adequate supports for proper mounting and operation of connected devices. Couplings for underground piping shall be Victaulic Style 77 or Gruvlok Fig. 7001 with Grade "E" gaskets. All other couplings shall be Victaulic Style 75 or Gruvlok Fig 7000 with Grade "E" gaskets. Taps to mains shall be made using Victaulic Style 72 or Style 920 or Gruvlok Fig. 7045/ 7046 outlet couplings or fittings. Mechanical "T" couplings with U-bolts shall not be permitted. Flange connections shall be made using Victaulic Style 741 or Gruvlok Fig. 7012 flanges with Grade "E" gaskets. Fittings for elbows, tees, reducers, and similar items shall be Victaulic or Gruvlok full flow fitting. All grooved piping couplings and fittings shall be the products of a single manufacturer and shall be UL listed for fire protection use as used on the project, including pressure and temperature ratings, pipe type and groove type. The use of boltless couplings, reducing couplings, mechanical "T" fittings with U-bolts and bolt on sprinkler head taps is prohibited. All grooved piping connection materials shall be used with the manufacturer' recommended groove rolling or cutting tool. All proposed grooved piping

connection materials shall be suitable for fire protection use at the temperatures and pressures at the point of application. Painted couplings may be utilized in lieu of galvanized couplings.

B. Piping Installation:

1. Piping shall be concealed, except in mechanical equipment rooms, stairwells, or where otherwise indicated on the Drawings. Install exposed piping parallel to or at right angles to the column lines of the building wherever possible.
2. Grade piping to eliminate traps and pockets and for drainage per NFPA 13 and NFPA 14. Where air pockets or water traps cannot be avoided, provide hose bibbs for drainage.
3. Piping shall be concealed above suspended ceilings where installed, in a craftsman like manner, and shall not interfere in the complete function of other systems such as cable trays, access panels, or pedestrian passageways. Piping in all occupied areas and mechanical area passageways shall not be lower than 9'-3". Specific written approval may be granted for unavoidable projections, but under no circumstances shall overhead piping be installed lower than 6'-8" above floor. Piping shall not reduce the required width of any means of egress, width of stairs, or clear width of corridor or passageways, to less than 44" in width. Installation of all piping shall be in coordination with piping ducts, light fixtures, and any other work that may obstruct sprinklers. The contractor shall coordinate with all trades having materials installed above the ceiling prior to commencement of any work.
4. Fire protection piping shall not be routed over electrical equipment. It shall be the responsibility of the Fire Protection Contractor to coordinate electrical equipment locations with the Electrical Contractor and design the fire protection piping system such that no piping is routed over electrical equipment.
5. All changes in direction, branches, offsets etc., shall be made with standard pipe fittings. Holes in the main for branches shall be made with a hole cutting machine and a standard "Weld-O-Let" or "Thread-O-Let" fitting used. Burning holes in the fire protection System Piping will cause that section of the piping to be cut out and replaced at the Contractor's expense.
6. All pipe shall be reamed to full pipe diameter before joining. Screwed joints shall be made with standard pipe thread and an approved compound applied to the male thread only. Welded joints shall be made in accordance with the procedure outlined in the A.S.A. piping code. Valves and specialties shall be screwed or flanged joints.
7. Install unions or flanges at equipment connections and as indicated on the Drawings.
8. Cold-springing piping will not be permitted. Install piping with adequate support to prevent strain on the equipment and to allow for piping system expansion and contraction.
9. Welded joints on pipe runs shall be made with continuous welds and with pipe ends beveled before fabrication. Piping shall be carefully aligned prior to welding and no metal shall project within the pipe.
10. Piping shall be sized as required by applicable codes and as indicated on the Drawings.
11. Field-grooving of pipe for Victaulic fittings shall use Victaulic groove depth control tool and a hole-cutting tool shall be used instead of burning a hole in the piping. Victaulic reducing couplings and outlet couplings shall not be installed. Victaulic gaskets shall be UL-approved for the service and working pressure of the systems.
12. Provide all test and drain lines as required by Section 3-11 of NFPA 13. Pressure gauges, signs, and other such standard appurtenances shall be furnished as required for a complete installation in accordance with NFPA 13. A nameplate data sign shall be provided at the zone controlling valve to identify the system as a hydraulically designed system indicating the location and basis for design in accordance with Chapter 7 of NFPA 13.

13. All sprinkler piping shall be so installed that it can be thoroughly drained, and where practicable shall be arranged to drain at the zone drain valve. The zone drain valve shall be capable of a full discharge test without allowing water to flow onto the floor. All drips and drains shall conform to Section 3-11 of NFPA No. 13.
  14. Field changes in the piping layout or pipe sizes shall not be made without the prior approval of the Engineer.
  15. All welding "cut-out" discs shall be retrieved and turned over to the Owner's Representative.
- C. **Pipe Hangers and Supports:**
1. Pipe supports, sway braces, hangers, and clamps shall conform to and be placed in accordance with Section 3-15 of NFPA 13 and listed by Underwriters' Laboratories, Inc., or approved by Factory Mutual.
  2. All pipe shall be supported from the building structure in a neat and workmanlike manner and wherever possible, parallel runs of horizontal piping shall be grouped together on trapeze type hangers. Vertical risers shall be supported at each floor line with steel pipe clamps. The use of wire or perforated metal to support pipes will not be permitted. Hanging pipes from other pipes will not be permitted. Spacing of pipe supports shall not exceed 10' on all piping.
  3. All standpipe and sprinkler piping shall be adequately supported to avoid excess strain on fittings and joints. As a minimum, all vertical risers shall be supported at the bottom level, the top level and at each alternate level in between.
  4. Where pendant sprinklers are used, care shall be taken to resist upward movement of flowing sprinklers by means of rigid hangers or other restraints on the ends of branch lines or arm-overs exceeding 5' in length. No flexible sprinkler head drops will be allowed.
- D. **Valve Stems:** Install valves with stems pointed up, in the vertical position where possible, but in no case with stems pointed downward from a horizontal plane. All valves shall be located so as to make the removal of their bonnets possible. All flanged valves shown in the horizontal lines with the valve stem in a horizontal position shall be positioned so that the valve stem is inclined one bolt hole above the horizontal position. Screw pattern valves placed in horizontal lines shall be made up with their valve stems inclined at an angle of 30 degrees above the horizontal position. All valves must be true and straight at the time the system is tested for final acceptance. Valves shall be installed as nearly as possible in the locations as shown on and Drawings. Any change in valve location must be so indicated on the As-built Drawings.
- E. **Valve Chain Operators:** In central plant and in fan or mechanical rooms where valves are installed over 8' above floor, provide chain operators.
- F. **Swing Check Valves:** Swing check valves shall be installed in horizontal piping only.
- G. **Unions and Companion Flanges:** Provide unions or companion flanges where required to facilitate dismantling of valves and equipment.
- H. **Access Doors and Panels:** Provide access doors or panels as required to provide full valve access. Refer to Section 23 03 00 for additional requirements.
- I. **Strainer Blowdown:** Provide a blowdown valve with hose connection and cap at each strainer for blowdown.
- J. **Gauges:** Provide gauges as required by NFPA 13 and NFPA 14 and as follows:
1. At the inlet of the pre-action .
  2. Where shown on the Drawings.

**3.2 PROTECTION DURING CONSTRUCTION:**

- A. Provide necessary fire protection during construction in accordance with NFPA and local codes.

**3.3 CLEANING AND STERILIZATION:**

- A. Cleaning all fire protection piping shall thoroughly flushed out to remove any slag or debris prior to being tested or put into service.

**3.4 VALVE SUPERVISORY SWITCHES:**

- A. All valves that affect the flow of fire protection water to any area shall be supervised. Supervisory switches shall be furnished and installed by this Contractor and wired by Division 16. Coordinate wiring of all switches with Division 16.

**3.5 WATERFLOW PRESSURE SWITCHES:**

- A. Waterflow pressure switches shall be furnished and installed by this Contractor in locations required by NFPA and where shown on the Drawings. Switches shall be wired by Division 16. Coordinate wiring of flow switches with Division 16.

**3.6 BUILDING FIRE ALARM SYSTEM INTERFACE:**

- A. Each panel shall provide an alarm signal output to the Building Fire Alarm System (wiring by Division 28) whenever waterflow conditions exist in the fire protection system.
- B. Each valve which controls the flow of sprinkler system water shall be monitored by the Building Fire Alarm System.

**3.7 TESTS AND INSPECTIONS:**

- A. Inspections, examinations and tests required by the authorities or agencies specified shall be arranged and paid for by the Fire Protection Subcontractor, as necessary, to obtain complete and final acceptance of the system as installed. The certificates of inspection shall be in quadruplicate, and shall be delivered to the Engineer for review and distribution.
- B. Fire protection piping systems shall be hydrostatically tested by the Contractor upon completion of the installation as required by NFPA 14, Section 1-11.2 of NFPA 13. When hydrostatic and alarm tests have been completed and all necessary corrections made, a material and test certification shall be provided in accordance with Section 1-12 of NFPA 13. Final inspection shall include full flow testing through the inspector's test connection. Actuation of the flow switch shall occur within one minute of opening of the inspector's test valve. The final tests may be witnessed by the Engineer or Owner's Representative.
- C. Pre-action sprinkler system shall be tested to demonstrate that system charge time is within the requirements of NFPA 13.
- D. Arrange and pay for all tests and inspections required by the AHJ.

**END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

This Page is Intentionally Blank

## SECTION 21 13 13

### WET-PIPE FIRE SPRINKLER SYSTEM

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS:

- A. The Conditions of the Contract and applicable requirements of Division 1, "General Requirements", and Section 23 00 00, "Mechanical General Provisions", govern this Section.

##### 1.2 DESCRIPTION OF WORK:

- A. This Section of the Specification includes providing all system design and installation labor and materials for modifications to the existing Building hydraulically calculated automatic, wet-pipe sprinkler systems to suit the new space plan improvements as specified herein and in Section 21 12 00, "Fire Protection Systems", and as shown on the Drawings, complete in all respects and ready for operation. The work includes the design and installation of wet-pipe automatic sprinkler system modifications, complete and ready for operation. Design and installation of the sprinkler system shall be such that no parts interfere with general construction, doors, windows, heating, plumbing, air conditioning systems or electrical equipment.
- B. The Work shall be installed in accordance with the Drawings and Specifications. All devices and equipment shall be listed by Underwriters' Laboratories, Inc. or Factory Mutual-approved, individually and as a system, as applicable.
- C. Sprinkler heads shall be spaced, located, and positioned as shown on the Architectural reflected ceiling plans, where shown, as specified herein and as required to suit the building partition layout according to NFPA 13. Piping sizes and configurations shall be on the basis of hydraulic calculations. Where head layouts shown on the Drawings or requirements specified herein are more stringent than NFPA requirements, the more stringent requirements shall apply. Special consideration of locations or conditions shall conform to NFPA 13.
- D. Existing building fire sprinkler zoning shall be retained.
- E. Coordinate the location of sprinkler heads and piping such that it does not interfere with the installed ceiling configuration or other building construction and equipment.

##### 1.3 HYDRAULIC CALCULATIONS:

- A. Hydraulic calculations shall be prepared in accordance with Chapter 22 of NFPA 13 with the following exceptions:
  - 1. Pipe friction losses may be calculated by using the nearest foot for all piping over one foot (1') in length. Horizontal lengths less than one foot (1') may be neglected. Vertical length less than one foot (1') shall be included for elevation purposes only.
  - 2. Flows shall be calculated to the nearest whole gallon.
  - 3. Velocity pressures may be neglected.
  - 4. Velocities in underground piping shall not exceed 16' per second. Velocities in all other piping shall not exceed 20' per second. Velocities in standpipes must be calculated based on the combined sprinkler flow and hose flow.
  - 5. Total sprinkler system flow shall not exceed 110% of the required flow.
  - 6. The combination standpipes accommodate both the sprinkler and standpipe hose stream flows. Each standpipe shall accommodate 250 gallons per minute flow for standpipe hose stream.

7. Hydraulic calculations shall be performed by a State of Texas Licensed Responsible Managing Employee (RME) in the direct employ of the fire protection contractor.
8. Provide 10 psi safety factor for all sprinkler system hydraulic calculations.
9. No flexible drop sprinkler heads will be allowed.

1.4 **QUALITY ASSURANCE:**

- A. Contractor: The fire protection system shall be designed and installed by Casteel Automatic Fire Protection, the Base Building fire protection contractor who is licensed by the State of Texas to perform fire protection work of the type specified for this project. The fire protection contractor shall have a minimum of 5 years of experience in the installation of fire protection work of the type specified for this project.
- B. Applicable Publications: City of Houston Building and Fire Codes, National Fire Codes as published by the National Fire Protection Association (NFPA), State Fire Marshal's requirements contain fire protection criteria and requirements for the design of all fire suppression systems. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
  1. National Fire Protection Association (NFPA):
    - a. NFPA 13 Standard for the Installation of Sprinkler Systems.
    - b. NFPA 70 National Electrical Code.
  2. Underwriters' Laboratories, Inc.:
    - a. Fire Protection Equipment Directory (Latest Addition).
  3. Factory Mutual Engineering Corporation (FM):
    - a. Approval Guild (Latest Addition).
  4. American National Standards Institute (ANSI):
    - a. Z 53 Safety Color Code for Marking Physical Hazards.
    - b. A 14 Safety Requirements for Fixed Ladders.
  5. Materials shall be installed in accordance with NFPA 13. All valves, fittings, hose, sprinkler heads, and equipment shall be UL or FM-labeled. All necessary points of city connections shall be matched to city equipment.
  6. Acceptable Manufacturers: The model numbers listed in the Specifications establish a level of quality and material. The following manufacturers are acceptable subject to compliance with the requirements of these Specifications.
    - a. Sprinkler Equipment:
      - 1) Viking Corporation.
      - 2) Grinnell Fire Protection Systems Co., Inc.
      - 3) Automatic Sprinkler Corporation.
      - 4) Central Sprinkler Corporation.
      - 5) Firematic Sprinkler Devices, Inc.
      - 6) Reliable Automatic Sprinkler Co.



## 1.5 SUBMITTALS:

- A. Shop drawing submittals shall include, but not be limited to:
  - 1. Preliminary submittal drawings showing all proposed sprinkler head locations for Architect/Engineer approval and including a layout and details sufficient to indicate the coordination of the location of sprinkler heads with the installed ceiling configuration shall be submitted for review and approval prior to proceeding with the design of the fire sprinkler system modifications..
  - 2. Cut sheets marked to clearly indicate all fire protection system materials, accessories and manufacturers to be used, including, but not limited to test/drain assemblies, pipe and fittings, pipe hangers and supports, valves, sprinkler heads, specialties, waterflow switches, valve supervisory switches, and other required materials. This shall include cut sheets on all grooved piping system components and all manufacturers which will be used on the project.
  - 3. The Contractor shall submit detailed and accurate shop drawings prepared in accordance with NFPA 13 for approval of all equipment to be constructed and installed. Shop drawings shall identify all materials and list all equipment to be used. Shop drawings shall include ceiling grid or reflected ceiling layout and shall be coordinated with other trades prior to submittal. Final fire protection system shop drawings showing all piping sizes and elevations, sprinkler head types and hydraulic calculations. Piping shall be sized and elevation of mains shall be indicated. Drawings shall be approved by state and local authorities prior to being submitted. Hydraulic calculations shall be a part of this submittal. A fire pump characteristic curve for the building fire pump shall be a part of this submittal.
  - 4. Hydraulic calculations for sprinkler systems shall comply with NFPA 13 and shall include comprehensive hydraulic data sheets. Provide a 10 psi safety factor for all sprinkler system hydraulic calculations.
  - 5. No work shall be performed without approved the shop drawings, calculations, and data sheets. The Contractor is solely liable for any work performed prior to this approval.
  - 6. The submittal shall include a statement from the sprinkler contractor certifying that the design meets the hydraulic design parameters stated in this Specification.
  - 7. Additional information as required in Section 23 00 01, "Mechanical General Provisions" and Section 21 12 00, "Fire Protection Systems".

## 1.6 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver sprinkler system components in factory-fabricated water resistant packaging.
- B. Handle sprinkler system components carefully to avoid damage to components, enclosures, and finish.
- C. Store sprinkler system components in a clean, dry space and protect from weather.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION:

- A. The wet-pipe sprinkler system shall be a fixed water type fire protection sprinkler system with a pressurized water supply to fusible sprinkler heads for control of fire. Flexible sprinkler head drops will be allowed.
- B. Sprinklers shall be listed or FM approved and shall not include O-rings seals. Any sprinkler that incurs damage, is painted, or is sprayed with any obstructive material during construction shall be replaced at no additional cost. Installation of sprinklers shall be coordinated with other work, including duct and electric fixture installation, to prevent sprinkler obstructions.

- C. Sprinklers located less than eight feet above finished floor or that may be subject to mechanical damage shall be provided with guards listed for use with the model of sprinkler installed.
- D. Quick-response sprinklers are required throughout all light-hazard occupancies, and may also be installed in ordinary-hazard occupancies for the quick-response hydraulic design area reduction per NFPA 13 for utilizing quick-response sprinklers. Extended coverage sprinklers may be utilized if proven in the hydraulic calculations.
- E. Where required by the project, sprinklers shall be centered in two directions in ceiling tiles. Pendent sprinklers required to be placed in the center of ceiling tiles, shall be supplied from a return bend that connects to an outlet at the top of the fire sprinkler branch line piping.
- F. The sprinkler system shall be designed to meet the more stringent of the requirements of NFPA 13 or the following requirements:
  - 1. Storage rooms and mechanical equipment room shall be hydraulically calculated and designed to provide 0.16 gpm/sf over the hydraulically most remote 3000 sf area (Ordinary Hazard Group 2) or over the entire area, whichever is less.
  - 2. Computer rooms and food service areas shall be hydraulically calculated and designed to provide 0.15 gpm/sf over the hydraulically most remote 2000 sf area (Ordinary Hazard Group 1) or over the entire area, whichever is less.
  - 3. Minimum design shall be hydraulically calculated and designed to provide 0.075 gpm/sf over the hydraulically most remote 2500 sf area.
  - 4. Office areas, conference areas and similar spaces shall be hydraulically calculated and designed to meet NFPA requirements for Light Hazard.
- G. All sprinkler heads in general shall be in a straight line, parallel to the lines of the building and shall be located exactly (double swing connection) in the center of ceiling tiles. Sprinkler heads shall be located where shown on the Architectural reflected ceiling plans, where shown. Sprinkler head quantities, where shown, are the minimum which must be provided. If additional heads are required to meet NFPA 13, the location of additional heads must be approved by the Architect. The Contractor shall submit Sprinkler Head locations to the Architect for location and type approval prior to completing the sprinkler system design, unless otherwise instructed, in writing, by the Architect.
- H. Sprinkler heads in rooms with electrical equipment shall be located as far as code requirements allow from electrical equipment.

## 2.2 **SYSTEM COMPONENTS:**

- A. System components for each zone shall include, but not be limited to:
  - 1. Base Building zone control (test/drain) assembly.
  - 2. Drain valves.
  - 3. Base Building waterflow switches.
  - 4. Base Building valve supervisory switches.
  - 5. New and reused Base Building piping.
  - 6. New and relocated/reused Base Building sprinkler heads.

## 2.3 **PIPE AND FITTINGS:**

- A. Refer to Section 21 12 00 for pipe and fitting requirements.

**2.4 PIPING FABRICATION/SHOP DRAWINGS:**

- A. Piping fabrication/shop drawings shall be submitted for all fire protection and sprinkler piping. Refer to Section 21 12 00 for additional requirements.

**2.5 PIPE HANGERS AND SUPPORTS:**

- A. Refer to Section 21 12 00 for pipe hanger and support requirements.

**2.6 SLEEVES AND ESCUTCHEONS:**

- A. Refer to Section 21 12 00 for pipe sleeve and escutcheon requirements.

**2.7 VALVES:**

- A. Refer to Section 21 12 00 for fire protection valve requirements.

**2.8 SPRINKLER HEADS/SPECIALTIES:**

- A. Unless otherwise specified, sprinkler heads shall have 165 deg F ordinary degree rating. Heads located within the air streams of heat emitting equipment and located at the top of elevator shafts shall be selected for proper temperature rating. Corrosion-resistant sprinkler heads shall be installed where they are exposed to weather, moisture, or corrosive vapors. Heads installed where they might receive mechanical injury or are less than 7' above the floor level shall be protected with approved guards in accordance with NFPA 13. Sprinkler guards shall be provided for sprinklers in electrical closets. Sprinklers in areas with suspended ceilings shall be pendant type, with pipe and fittings located above the suspended ceiling.
- B. Sprinkler heads in finished public areas shall be concealed pendant fire sprinkler heads to match the existing Building fire sprinkler heads with coverplate colors to match the ceiling color where the sprinkler head is installed.

**2.9 VALVE SUPERVISORY SWITCHES:**

- A. Existing to remain and be reused.

**2.10 WATERFLOW SWITCHES:**

- A. Existing to remain and be reused.

**2.11 BUILDING FIRE ALARM SYSTEM INTERFACE:**

- A. Existing to remain and be reused.

**PART 3 - EXECUTION**

**3.1 INSTALLATION:**

- A. General: Refer to Section 21 12 00 for installation of fire protection system piping and other general requirements.
- B. Inspector's Test Valves: Test valves shall be provided in accordance with NFPA 13, supplied from the highest and most remote part of the system in relation to the riser assembly, and shall discharge to the outside of the building or to a building drain. Test valves shall be conveniently accessible within 7' of floor. Inspector's test connections must be provided for all zones, so that the waterflow switch for the zone can be tested. Every water flow switch shall have an inspector's test connection located downstream of the water flow switch and piped to the sanitary sewer system or other acceptable location.

- C. Protection During Construction: Provide necessary fire protection during construction in accordance with NFPA and applicable codes.
- D. System Drains: All trapped portions of the system shall be equipped with drains of the size specified in NFPA 13. Where possible, design a system that will completely drain to the system riser. Where any trapped water exists, provide an auxiliary drain per NFPA 13 and pipe to the sanitary sewer system or other acceptable location.

**3.2 CLEANING:**

- A. All fire protection piping shall thoroughly flushed out to remove any slag or debris prior to being tested or put into service.

**3.3 SYSTEM PRESSURE REDUCTION:**

- A. Where fire system pressures exceed 175 psi, provide of the pressure reducing valves to regulate the pressure at that point to 165 psi.

**3.4 TESTS AND INSPECTIONS:**

- A. Inspections, examinations and tests required by the authorities or agencies specified shall be arranged and paid for by the Fire Protection Subcontractor, as necessary, to obtain complete and final acceptance of the system as installed. The certificates of inspection shall be in quadruplicate, and shall be delivered to the Engineer for review and distribution.
- B. Sprinkler systems shall be hydrostatically tested by the Contractor upon completion of the installation as required by NFPA 13. When hydrostatic and alarm tests have been completed and all necessary corrections made, a material and test certification shall be provided in accordance with NFPA 13. Final inspection shall include full flow testing through the inspector's test connection. Actuation of the flow switch shall occur within one minute of opening of the inspector's test valve. The final tests may be witnessed by the Engineer or Owner's Representative.
- C. Sprinkler system zone control assemblies shall be tested to demonstrate proper operation of the flow switch and valve supervisory switch.
- D. Arrange and pay for all tests and inspections required by City of Houston Fire Marshall.

**3.5 PERIODIC INSPECTION SERVICE:**

- A. Refer to Section 21 12 00 for requirements.
- B. This agreement shall be executed at no cost to the Owner and shall include four inspections of the entire sprinkler system during the warranty period, each with a "Report of Inspection to the Owner". The final inspection shall include operation and lubrication of all valves, cleaning of all alarm valves and operational testing of all system Electrical and alarm components.

**3.6 IDENTIFICATION:**

- A. Refer to Section 23 03 00 for applicable painting, nameplates and labeling requirements. All drain valves, test valves and other system valves shall be clearly labeled as to use and the fact that they are fire protection system valves.

**END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

## SECTION 22 13 16

### PLUMBING PIPING

#### PART 1 GENERAL

1.00 **RELATED DOCUMENTS** The following sections are to be included as if written herein:

- A. Section 23 00 00 – Basic Mechanical Requirements
- B. Section 23 05 29 – Sleeves, Flashings, Supports and Anchors
- C. Section 23 05 53 – Mechanical Identification

#### 1.01 SECTION INCLUDES

- A. Pipe and Pipe Fittings
- B. Valves

#### 1.02 RELATED SECTIONS

- A. Section 23 20 00.A - Piping, Valves and Fittings
- B. Section 23 05 16 - Expansion Compensation
- Cl. Section 23 05 48 - Vibration Isolation
- DJ. Section 23 07 19 - Piping Insulation

#### 1.03 REFERENCES

- A. See Section 23 20 00

#### 1.04 SUBMITTALS

- A. Submit under provisions of Section 23 00 00.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

#### 1.05 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 23 00 00.
- B. Record actual locations of valves, etc., and prepare valve charts.

#### 1.06 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 23 00 00.
- B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

**1.07 QUALITY ASSURANCE**

- A. See Section 23 20 00.A

**1.08 QUALIFICATIONS**

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing the work of this section with minimum of three years documented experience.

**1.09 REGULATORY REQUIREMENTS**

- A. Perform Work in accordance with Uniform Plumbing Code.
- B. Conform to applicable code for installation of backflow prevention devices.

**1.10 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, protect and handle products to site under provisions of Section 23 00 00.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

**1.11 ENVIRONMENTAL REQUIREMENTS**

- A. Do not install underground piping when bedding is wet or frozen.

**1.12 EXTRA MATERIALS**

- A. Furnish under provisions of Section 23 00 00.
- B. Provide two repacking kits for each size valve.

**PART 2 PRODUCTS**

**2.01 SLEEVES, INSERTS, AND FASTENINGS:**

See Section 23 05 29.

**2.02 VALVES:**

- A. See Section 23 20 00.A

**2.03 UNIONS:**

- A. See Section 23 20 00.A.
- B. Unions connecting ferrous pipe to copper or brass pipe shall be dielectric type equal to EpcO.
- C. In all domestic water lines where the material of the pipe is changed from ferrous to copper or brass, a dielectric coupling shall be used at the transition.

**2.04 FLANGES:**

- A. See Section 23 20 00.A.

**2.05 SANITARY DRAINAGE SYSTEM:**

- A. The sanitary drainage system shall be installed as indicated on the Drawings complete with all fixtures, drains, traps and required connections. All fixtures and drains shall be properly vented and trapped. The Contractor shall complete the installation of the sanitary drainage system by making approved connections as indicated on the Drawings.
- B. Materials and installation of the system shall be as specified in the following paragraphs and Section 23 20 00.A.
- C. PIPE AND FITTINGS:
  - 1. All pipe used for interior, above ground sewer and drainage purposes, unless specifically shown to the contrary, shall be service weight cast iron soil pipe.
  - 2. All pipe and fittings from the sump pumps and sewage ejectors shall be Schedule 80 PVC with PVC bolted flange connections at pump discharge and at each valve. PVC piping shall be run from the pumps to the exterior piping connection point within 6" of 5'-0" outside of the building.
  - 3. Galvanized or black steel pipe shall not be used in any waste connection to a fixture or in any section of the soil or waste piping system.
  - 4. All underground sanitary waste piping, of all sizes, shall be cast iron hub and spigot type, with Tyseal (or approved equal) neoprene gaskets. Hubless piping systems shall not be used in a directly buried, underground application.
- D. INSTALLATION OF PIPING:
  - 1. All piping shall be run in the most direct manner. Horizontal pipes shall have a grade of one-quarter inch (1/4") per foot, wherever possible, and not less in any case than one-eighth inch (1/8") per foot, unless otherwise noted on Drawings.
  - 2. Cleanouts shall be provided at the bottom of each riser, at each change of direction and at intervals not exceeding 95 feet in horizontal runs. Interior cleanouts shall be brass caulked into the lines, and where they occur in walls or floors of finished areas, shall be provided with nickel-bronze tops or access plates. All interior cleanouts shall be of the same size as the pipe served up to four inch (4") size and four inches (4") for all larger lines.

3. Exterior cleanouts shall consist of a concrete encased wye in the line with sewer pipe extending upward therefrom and terminating in a concrete slab below grade. A standard cast iron cleanout casting shall be set on this slab in such manner as to be flush with finished grade and to provide access through its cover to the cleanout. A removable concrete stopper shall be set in the open top of the cleanout pipe.

E. FLASHINGS:

1. All vent pipes passing through the roof shall be provided with roof flashings per Section 23 05 29.

F. TESTING:

1. After the vertical lines of soil pipe, waste, and other parts of the sanitary system have been set from the basement to the top of the building, all outlets shall be temporarily "plugged up", except as are required for testing as described herein. One floor level of the building shall be tested at a time. Each floor shall be tested from a level below the structure of the floor, or the outlet of the building in the case of the lowest level, to a level of 12 inches above the floor immediately above the floor being tested, or the top of the highest vent in the case of the highest building level. The pipes for the level being tested shall be filled with water to a verifiable and visible level as described above and be allowed to remain so for 24 hours. If after 24 hours the level of the water has been lowered by leakage, the leaks must be found and stopped, and the water level shall again be raised to the level described, and the test repeated until, after a 24 hour retention period, there shall be no perceptible lowering of the water level in the system being tested.
2. A final test shall be conducted after all vertical and horizontal pipes and "rough-ins" have been complete but before the sewer connection is made. The test procedure shall be identical with that described above except that the entire plumbing system, i.e., the vertical and horizontal pipe and "rough-in", shall be subjected to water under the head imposed by filling the system to the top of the building. After all testing operations have been completed, all waste lines shall be cleaned.
3. Should the completion of these tests leave any reasonable question of a doubt relative to the integrity of the installation, additional tests or measures shall be performed to demonstrate the reliability of these systems to the complete satisfaction of the Owner's duly authorized representative. Such tests shall be conducted and completed before any joints in plumbing are concealed or made inaccessible.

G. FABRICATION METHODS FOR SEWAGE AND DRAINAGE PIPE LINES:

1. Install promptly all sewers, drains and piping after excavating, chasing or cutting for them has been done to keep the openings for such piping open as short a time as possible. No piping shall, however, be permanently closed up, furred in or covered before the examination of same by the authorities having jurisdiction.
2. Waste pipes shall be sized to conform to the sizes indicated on the Drawings. Under no circumstances shall any drain line be smaller than two inches. The waste pipes from water closets shall not be smaller than four inches.
3. The drilling and tapping of soil or waste lines or the use of saddle joints or the welding or brazing of hubs or pipe to any soil, waste or vent lines is prohibited.



4. Wastes must be brought up directly in back of each fixture. Horizontal branch arms of lead or brass will not be allowed.
  5. No waste or soil lines shall enter the vertical part or heel of a lead or cast iron closet bend. Waste lines may enter the horizontal part of the lead or cast iron closet bend. No sink or lavatory waste line shall enter any other waste line of two inch (2") size.
  6. All waste connections shall be made of heavy brass threaded nipples or with copper tube with appropriate screw to sweat adapters for connecting to sanitary tee. All fixtures used in connection with the conveying of any waste substance to the sanitary sewer, shall be connected by means of a trap, waste and overflow. Slip joints will be permitted only on the house side of the trap, waste and overflow, or appliance which has such slip joints embodied in their original manufacture. Fixtures which have waste opening connected to the soil or waste lines by the use of bolts or screws shall have such connections made by the use of the exact number of bolts or screws as provided for in their original manufacture.
  7. Where waste and vents are exposed at fixtures, pipes shall be chrome plated brass or brass W.C.P. cover (iron pipe size) and shall have chrome plated escutcheons where they pass through floors, walls, or ceilings.
- H. VENTS:
1. Vent pipes shall be carried up adjoining soil and waste pipes, and they shall be connected into the main stack at top and bottom as indicated on the plumbing riser diagrams on the Drawings.
  2. Vent pipes shall be of hubless service weight cast iron pipe.
  3. All vent lines shall be so constructed that they cannot be used for waste or soil lines. No fixture shall be double trapped.
- I. CONNECTIONS FOR FLOOR MOUNTED WATER CLOSETS:
1. All connections for floor mounted water closets and waste piping shall be made with an appropriate cast iron closet flange and wax gaskets.

**2.06 WATER SUPPLY SYSTEM:**

- A. A complete system of hot and cold water supply to all plumbing fixtures and mechanical equipment shall be supplied and installed as shown on the Drawings. The water supply system is existing.

**2.07 INTERIOR DOMESTIC WATER PIPING SYSTEMS:**

- A. All piping within confines of building walls shall be a part of the interior water piping system. Interior domestic water piping material and installation shall be as specified in the following paragraphs.
- B. PIPE:
1. Interior domestic water piping larger than six inches (6") shall be Schedule 40 galvanized steel pipe. See Section 23 20 00.A.

a) When approved by the Owner in writing, the use of roll-grooved copper pipe may be used.

2. Unless otherwise shown on the Drawings, all interior domestic water piping four inches (4") and smaller shall be fabricated of Type K, hard drawn, copper pipe made of deoxidized copper (99.9% pure). See Section 23 20 00.A.  
No pipe smaller than three-fourths inches (3/4") shall be used in this project except at local connections or as detailed for laboratory areas.

C. FITTINGS:

1. See Section 23 20 00.A.

D. HEADERS:

1. Suitable headers of the nature detailed on the accompanying Drawings shall be provided for the distribution of the cold water systems. These headers shall be fabricated by a fusion welding process by the use of extra strong black steel pipe and fittings of the same character. All flanges used in the case of such headers shall be dimensioned, faced, drilled and spot faced to conform to the Class 150 American Standard for Steel Pipe Flanges and Flanged Fittings (B16e-1939). The header outlets shall be effected by welding to the header full length welding couplings of the proper size. These header outlets shall be carefully aligned to be "square" and parallel.
2. Upon being completed, these headers shall be subjected to a hydrostatic test of 300 pounds per square inch gauge. All defects noted upon inspecting the headers thus tested shall be repaired by chipping, machining and burning out defects, and re-welding. After repairs have been made, the headers shall be retested as described above.
3. After the headers have been tested and found to be tight, they shall be galvanized by a "double-dip" process. The manufacturer shall be required to provide certificates assuring the fact that the headers were so "double-dipped". Both exterior and interior surfaces shall receive a heavy zinc coating by a hot dipping process. Galvanized steel nipples shall be used to extend the various header outlets to the valves placed in each outgoing water line near the header. These nipples shall be of such a length that the valves in the outgoing water lines are neatly lined up in a horizontal plane. At a point just beyond these valves, a three-fourths inch (3/4") valved drain line shall be installed in each outgoing branch leaving the header. The purpose of such valve branches shall be to drain the system into which the flow of water is controlled by the valves previously mentioned. These three-fourths inch (3/4") drain line valves from the various branches leaving the headers shall be likewise lined up in a straight horizontal line. These three-fourths inch (3/4") drain lines shall terminate in a common "drain line". That one inch (1") drain line shall be the header drain line. Headers fabricated from copper pipe and roll grooved fittings may be substituted only with the written approval of the owner.

E. CONTROL VALVES:

1. Control valves shall be installed where indicated on Drawings and/or wherever necessary for controlling the several sections of the domestic water system. Valves shall be provided on all inlet (and outlet where applicable) connections to all kinds of apparatuses, all risers and all groups of fixtures. Groups of fixtures shall be arranged to have their group valves in one location. Access shall be provided to all concealed valves by means

of an access door. Coordinate the location of valves with the architectural features of the building in order that the access doors will be located symmetrically with other features.

2. The hot and/or cold water supply lines to each and every fixture hereinafter specified shall be equipped with stop valves which shall be chromium plated where exposed chrome plated pipe is used.

F. CROSS CONNECTIONS:

1. Care shall be exercised in fabricating plumbing lines to avoid all cross connections and to construct the piping systems in a manner which eliminates the possibility of water contamination.
2. The piping systems have been designed in every case to avoid the possibility of reverse flow or back siphoning. Care shall be exercised in constructing plumbing lines to make certain that not only the letter, but the spirit, of these safety precautions is carried out to the fullest possible extent.

G. REQUIREMENTS OF INTERIOR WATER PIPING SYSTEMS:

1. All piping shall have reducing fittings used for reducing or increasing where any change in the pipe sizes occurs. No bushing of any nature shall be allowed in piping.
2. All exposed chrome plated, polished or enameled connections from fixtures shall be put up with special care, showing no tool marks or threads at fittings, and supported by neat racks or hangers with round head screws of same material and finish.
3. Wade Shokstop, or approved equal, sealed air chambers shall be provided in all water branches to fixtures, sized in accordance with manufacturer's recommendations, concealed, accessible, and located so as to protect each group of plumbing fixtures.
4. The fabrication of copper pipe and fittings shall in every detail conform to the recommendations and instructions of the fitting manufacturer. The tools used shall be the tools adapted to that specific purpose.
5. Refer to other parts of this Section and Section 23 00 00 and 23 20 00.A for other information concerning installation of piping.

H. TESTING AND STERILIZATION:

1. All water piping systems shall be properly tested to assure their being absolutely tight. In the case of pipes which are to be insulated, these tests shall be completed and the piping system proven to be absolutely tight before any insulation is applied. Wherever pipes are placed so that they will ultimately be concealed, these tests shall be conducted and the absolute tightness of each piping system shall be demonstrated before the system is concealed.
2. The procedure of these tests shall consist of subjecting a piping system to a hydrostatic pressure per Section 23 00 00. During the test period, all pipe, fittings and accessories in the particular piping system which is being tested shall be carefully inspected. If leaks are detected, such leaks shall be stopped by means designated by the Owner's duly authorized representative and the hydrostatic test shall again be applied. This procedure shall be repeated until, for an entire twenty-four hour period, no leaks can be found while the system being tested is subjected to the pressure mentioned above.

3. Wherever conditions permit, each piping system shall thereafter be subjected to its normal operating pressure and temperature for a period of no less than five (5) days. During that period, it shall be kept under the most careful observation. The piping systems must demonstrate the propriety of their installation by remaining absolutely tight during this period. Even though the completion of these tests is satisfactory, there is a continuing responsibility for the ultimate, proper, and satisfactory operation of such piping systems and their accessories.
4. After completion of the testing, the entire cold and hot water piping systems, with attached equipment, shall be thoroughly sterilized with a solution containing not less than 50 parts per million of available chlorine. The chlorinating materials shall be either liquid chlorine conforming to U. S. Army Specification No. 4-1 or calcium hypochlorite or chlorinated lime conforming to the requirements of Federal Specification O-C-114. The sterilizing solution shall be allowed to remain in the system for a period of eight (8) hours during which time all valves and faucets shall be opened and closed several times. After sterilization, the solution shall be flushed from the system with clean water until the residual chlorine content is not greater than 0.2 parts per million.
5. The sterilization process shall be conducted as required by the Health Department of the City of Houston, and the specifications above, and upon completion of the process, the Health Department shall test and certify the cleanliness of the water piping system. The Mechanical Subcontractor shall pay all costs and charges incidental to this test and certification.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify excavations under provisions of Section 23 00 00.
- B. Verify that excavations are to required grade, dry, and not over-excavated.

#### **3.02 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.

#### **3.03 INSTALLATION**

- A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- B. Route piping in orderly manner and maintain gradient.
- C. Install piping to conserve building space and not interfere with use of space.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

- F. Provide clearance for installation of insulation and access to valves and fittings.
- G. Provide access where valves and fittings are not exposed. Coordinate access door location with architectural features.
- H. Establish elevations of buried piping outside the building to ensure a minimum of cover. Refer to Section 23 00 00.
- I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- J. Provide support for utility meters in accordance with requirements of utility companies.
- K. Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting. Refer to Division 09.
- M. Install bell and spigot pipe with bell end upstream.
- N. Install valves with stems upright or horizontal, not inverted.
- O. Provide one plug valve wrench for every ten plug valves sized 2 inches and smaller, minimum of one. Provide each plug valve sized 2-1/2 inches and larger with a wrench with set screw.
- P. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.

#### **3.04 APPLICATION**

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.
- C. Install ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- D. Install globe or plug valves for throttling, bypass, or manual flow control services.
- E. Provide spring loaded check valves on discharge of water pumps.
- F. Provide plug valves in Natural gas systems for shut-off service.
- G. Provide flow controls in water recirculating systems where indicated.

#### **3.05 ERECTION TOLERANCES**

- A. Establish invert elevations, slopes for drainage to 1/8 inch per foot (one percent) minimum. Maintain gradients through each joint of pipe and throughout system.
- B. Slope water piping and arrange to drain at low points.

#### **3.06 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM**

- A. Prior to starting work, verify system is complete, flushed and clean.

- B. Ensure PH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- E. Maintain disinfectant in system for 24 hours.
- F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

**3.07 EQUIPMENT CONNECTIONS:**

- A. Under this section, water lines shall be run to and connected to the pumps, quick fills, and other items of equipment as indicated. Provide suitable shutoff valves, check valves, and, if required by the drawings, bypass valves at each and every such point of connection.

**3.08 CONNECTIONS FOR GENERAL CONTRACTOR FURNISHED EQUIPMENT:**

- A. Route lines as indicated on the Drawings to serve various items of equipment specified elsewhere. Rough-in accordance with detailed drawings furnished by the equipment supplier, and make final connections to the equipment when it is installed. Rough-in shall terminate where noted on Drawings. All pressure lines shall be provided with shutoff valves or cocks. Drain lines shall be provided where required. It shall be assumed that the equipment supplier will provide and install valves and pipe specialties, etc. only as specified herein or called for on the Drawings.
- B. Laboratory and/or other special equipment and trim are specified in another section under which the equipment shall be furnished and installed. Trim, sink strainers and tail pieces shall be furnished only as indicated to the contractor who shall receive, store and install them. In addition, furnish the sink P-traps and all materials and labor to rough-in and make final connections.

**3.09 CONNECTIONS FOR OWNER FURNISHED EQUIPMENT:**

- A. The Owner will be furnishing various pieces of equipment. The Contractor shall provide the rough-in indicated on the Drawings. Final connections are also included as part of this contract.

**END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

**SECTION 22 15 13**  
**COMPRESSED AIR SYSTEM**

**PART 1 GENERAL**

**1.00 RELATED DOCUMENTS** The following sections are to be included as if written herein:

- A. Section 23 00 00 – Basic Mechanical Requirements
- B. Section 23 05 29 – Sleeves, Flashings, Supports and Anchors
- C. Section 23 05 53 – Mechanical Identification

**1.01 SECTION INCLUDES**

- A. Pipe and Pipe Fittings

**1.02 RELATED SECTIONS**

- A. Section 22 13 16.UT - Plumbing Piping
- B. Section 26 05 19 - Cable, Wire and Connectors, 600 Volt: Electrical characteristics, cable, wire, materials

**1.03 REFERENCES**

- A. ASME - Boiler and Pressure Vessel Code
- B. ASME B16.3 - Malleable Iron Threaded Fittings
- C. ASME B16.18 - Cast Bronze Solder-Joint Pressure Fittings
- D. ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings
- E. ASME B16.26 - Cast Bronze Fittings for Flared Copper Tubes
- F. ASME B31.1 - Power Piping
- G. ASME B31.9 - Building Services Piping
- H. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless
- I. ASTM A120 - Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized), Welded and Seamless, for Ordinary Uses
- J. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
- K. ASTM B32 - Solder Metal
- L. ASTM B88 - Seamless Copper Water Tube

- M. ASTM D2513 - Thermoplastic Gas Pressure Pipe, Tubing and Fittings
- N. ASTM D2683 - Socket-Type Polyethylene Fillings for Outside Diameter-Controlled Polyethylene Pipe
- O. NFPA 70 - National Electrical Code

**1.04 SUBMITTALS**

- A. Submit under provisions of Section 23 00 00.
- B. Shop Drawings: Indicate piping system schematic with electrical characteristics and connection requirements.
- C. Product Data: Provide manufacturers catalog literature with capacity, weight, and electrical characteristics and connection requirements.
- D. Test Reports: Submit inspector's certificate for air receiver for inclusion in Operating and Maintenance Manuals.
- E. Manufacturer's Installation Instructions: Indicate hoisting and setting requirements, starting procedures.

**1.05 PROJECT RECORD DOCUMENTS**

- A. Submit under provisions of Section 23 00 00.
- B. Record actual locations of equipment and components. Modify shop drawings to indicate final locations.

**1.06 OPERATION AND MAINTENANCE DATA**

- A. Submit under provisions of Section 23 00 00.
- B. Operation Data: Submit for air compressor, air receiver and accessories, after cooler, refrigerated air dryer, and pressure reducing station.
- C. Maintenance Data: Submit for air compressor, air receiver and accessories, after cooler, refrigerated air dryer, and pressure reducing station.

**1.07 REGULATORY REQUIREMENTS**

- A. Conform to ASME codes for installation of pressure vessels.
- B. Provide certificate of compliance from Factory Mutual indicating approval of air receiver.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc., as suitable for the purpose specified and indicated.

**1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, protect and handle products to site under provisions of Section 23 00 00.



- B. Accept air compressors, refrigerated air dryer on site in factory fabricated containers with shipping skids and plastic pipe end protectors in place. Inspect for damage.
- C. Protect piping and equipment from weather and construction traffic.

## **PART 2 PRODUCTS**

### **2.01 LABORATORY FITTINGS:**

- A. Laboratory fittings will be furnished to the job site by the Laboratory Equipment Supplier, with necessary holes cut in the laboratory equipment. The Contractor shall receive, store, and install the fittings and make all necessary connections thereto.

### **2.02 PIPING:**

- A. Compressed air piping shall be ASTM Specification B-88, Type K, hard drawn, seamless copper tubing with wrought copper solder fittings. No ferrous piping will be permitted in the system. Where threaded nipples are required these shall be I.P.S. brass.
- B. All piping shall be pitched back so as to drain to the point shown on the Drawings. All branch air take-offs shall be made from the top of the mains.

### **2.03 VALVES:**

- A. Compressed air and laboratory or medical gas valves shall be Spirax Sarco Model 60, stainless steel ball valves, with screwed joint and Teflon seats.

### **2.04 TESTS:**

- A. All air lines shall be tested at 150 pounds per square inch and proved tight at this pressure. All tests shall be observed by a representative of the Architect before the tests are removed.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install equipment in accordance with manufacturer's instructions.
- B. Make air cock and drain connection on horizontal casing.
- C. Install valved drip connections at low points of piping system.
- D. Install take offs to outlets from top of main, with shut off valve after take off. Slope take-off piping to outlets.
- E. Install compressed air couplings, female quick connectors, and pressure gauges where outlets are indicated.
- F. Install tees instead of elbows at changes in direction of piping. Fit open end of each tee with plug.
- G. Identify and label piping system and components. Refer to Section 23 05 53.

**3.02 FIELD QUALITY CONTROL**

- A. Field inspection and testing will be performed under provisions of Section 23 00 00.UT (including Uniform General Conditions as referenced therein), and Section 22 13 16.
- B. Compressed Air Piping Leak Test: Prior to initial operation, clean and test compressed air piping in accordance with ANSI B31.1.
- C. Repair or replace compressed air piping as required to eliminate leaks, and retest to demonstrate compliance.
- D. Cap (seal) ends of piping when not connected to mechanical equipment.

**END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

## SECTION 23 00 00

### BASIC MECHANICAL REQUIREMENTS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Basic Mechanical Requirements specifically applicable to Division 23 Sections, in addition to Division 01 - General Requirements.

##### 1.02 RELATED DOCUMENTS:

- A. THE UNIFORM GENERAL CONDITIONS, SUPPLEMENTARY GENERAL CONDITIONS, and DIVISION 01 of the Specifications apply to the work specified in this Section.
- B. All work covered by this Section of these Specifications shall be accomplished in accordance with all applicable provisions of the Contract Documents and any addenda or directives which may be issued herewith, or otherwise.

##### 1.03 GENERAL:

- A. The Contractor shall execute all work hereinafter specified or indicated on accompanying Drawings. Contractor shall provide all equipment necessary and usually furnished in connection with such work and systems whether or not mentioned specifically herein or on the Drawings.
- B. The Contractor shall be responsible for fitting his material and apparatus into the building and shall carefully lay out his work at the site to conform to the structural conditions, to avoid all obstructions, to conform to the details of the installation and thereby to provide an integrated satisfactory operating installation.
- C. The Mechanical, Electrical, and associated Drawings are necessarily diagrammatic by their nature, and are not intended to show every connection in detail or every pipe or conduit in its exact location. These details are subject to the requirements of standards referenced elsewhere in these specifications, and structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be organized and laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- D. When the mechanical and electrical Drawings do not give exact details as to the elevation of pipe, conduit and ducts, the Contractor shall physically arrange the systems to fit in the space available at the elevations intended with proper grades for the functioning of the system involved. Piping, exposed conduit and the duct systems are generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets, control lines, pilot lines and other location details. Work shall be concealed in all finished areas.

- 1.04 DEFINITIONS:** (Note: These definitions are included here to clarify the direction and intention of this specification. The list given here is not by any means complete. For further clarification as required, contractor shall contact the designated owner's representative.)

- A. CONCEALED / EXPOSED: Concealed areas are those areas which cannot be seen by the building occupants. Exposed areas are all areas which are exposed to view by the building occupants, including under counters, inside cabinets and closets, plus all mechanical rooms.
- B. General Requirements: The provisions of requirements of other Division 01 sections apply to entire work of contract and, where so indicated, to other elements which are included in project. Basic contract definitions are included in the General Conditions.
- C. Indicated: The term "indicated" is a cross reference to graphic representations, notes or schedules on drawings, to other paragraphs or schedules in the Specifications, and to similar means of recording requirements on contract documents. Where terms such as "shown", "noted", "scheduled", and "specified" are used in lieu of "indicated", it is for the purpose of helping reader locate the cross reference, and no limitation of location is intended except as specifically noted.
- D. Directed, requested, etc.: Where not otherwise explained, terms such as "directed", "requested", "authorized", "selected", "approved", "required", "accepted", and "permitted" mean directed by Architect/Engineer", "requested by Architect/Engineer" and similar phrases. However, no such implied meaning will be interpreted to extend Architect's/Engineer's responsibility into Contractor's area of construction supervision and job safety.
- E. And/Or: Where "and/or" is used in these Specifications or on the Drawings, it shall mean "that situations exist where either one or both conditions occur or are required and shall not be interpreted to permit an option on the part of the Contractor.
- F. Approve: Where used in conjunction with Architect's/Engineer's response to submittals, requests, applications, inquiries, reports and claims by Contractor, the meaning of term "approved" will be held to limitations to Architect's/Engineer's responsibilities and duties as specified in General and Supplementary Conditions. In no case will "approval" by Architect/Engineer be interpreted as a release of Contractor from responsibilities to fulfill requirements of contract documents or to extend Architect's/Engineer's responsibility into Contractor's area of construction supervision and job safety.
- G. As required: Where "as required" is used in these Specifications or on the drawings, it shall mean "that situations exist that are not necessarily described in detail or indicated that may cause the contractor certain complications in performing the work described or indicated. These complications entail the normal coordination activities expected of the Contractor where multiple trades are involved and new or existing construction causes deviations to otherwise simplistic approaches to the work to be performed. The term shall not be interpreted to permit an option on the part of the Contractor to achieve the end result."
- H. Furnish:
1. The term "furnish" is used to mean "supply and deliver to project site, ready for unloading, unpacking, assemble, installation, and similar operations."
  2. Where "furnish" applies to work for which the installation is not otherwise specified, "furnish" in such case shall mean "furnish and install."
- I. Install: The term "install" is used to describe operations at project site including "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operation."

- J. Provide: The term "provide" means "to furnish and install, complete and ready for intended use."

#### **1.05 PERMITS, UTILITY CONNECTIONS AND INSPECTIONS:**

- A. General: Refer to DIVISION 01 for construction phasing and time increments.
- B. Fees and Costs: Refer to Division 01 for payment requirements of fees and utility costs.
- C. All work performed on this project is under the authority of the State of Texas, therefore no local construction fees or construction permits will be required except as may be required for new service taps, or new or modified connections to City controlled services. If inspections by City personnel are specifically required by this document, refer to Division 01 for responsibility.
- D. Compliance: The Contractor shall comply in every respect with all requirements of National Fire Protection Association, local Fire Department regulations and utility company requirements. In no case does this relieve the Contractor of the responsibility of complying with these Specifications and Drawings where specified conditions are of higher quality than the requirements of the above-specified authorities. Where requirements of the Specifications and Drawings are more lenient than the requirements of the above authorities having jurisdiction, the Contractor shall make installations in compliance with the requirements of the above authorities with no extra compensation.

#### **1.06 CONTRACT DOCUMENTS:**

- A. All dimensional information related to new structures shall be taken from the appropriate Drawings. All dimensional information related to existing facilities shall be taken from actual measurements made by the Contractor on the site.
- B. The interrelation of the Specifications, the Drawings, and the schedules are as follows: The Specifications determine the nature and setting of the several materials, the Drawings establish the quantities, dimensions and details, and the schedules give the performance characteristics. If the Contractor requires additional clarification, he shall request it in writing, following the contractually prescribed information flow requirements.
- C. Should the Drawings or Specifications conflict within themselves, or with each other, the better quality, or greater size or quantity of work or materials shall be performed or furnished.

#### **1.07 FUTURE WORK**

- A. Provide for future work under requirements of Section 01 11 00.

#### **1.08 SUBMITTALS**

- A. Refer to Uniform General Conditions.
- B. Proposed Products List: Include Products specified in the following Sections:
  - 1. Section 23 05 29 - Sleeves, Flashings, Supports and Anchors
  - 2. Section 21 12 00 – Fire Protection Systems
  - 3. Section 21 13 13 – Wet Pipe Fire Sprinkler System

- C. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.
- D. Mark dimensions and values in units to match those specified.
- E. Submit Fabrication Drawings whenever (1) equipment proposed varies in physical size and arrangement from that indicated on the Drawings, thus causing rearrangement of equipment space, (2) where tight spaces require extreme coordination between ductwork, piping, conduit, and other equipment, (3) where called for elsewhere in these Specifications; and (4) where specifically requested by the Architect/Engineer. Fabrication Drawings shall be made at no additional charge to the Owner or the Architect/Engineer.
- F. All required Fabrication Drawings, except as noted otherwise, shall be prepared at a scale of not less than  $1/4" = 1'-0"$ . Fabrication Drawings for ductwork, air handling units, and sections in Mechanical Rooms shall be drawn at a minimum scale of  $3/8" = 1'-0"$ . Submit three blue-line prints of each Fabrication Drawing to the Architect/Engineer for review. Reproduction and submittal of the Construction Documents is not acceptable. The Architect/Engineer will review the drawing and return one print with comments.

#### **1.09 SUBSTITUTION OF MATERIALS AND EQUIPMENT:**

- A. Refer to General Conditions for substitution of materials and equipment.
- B. General: Within thirty days after the date of contract award or work order, whichever is later, and before purchasing or starting installation of materials or equipment, the Contractor shall submit for review, a complete list of suppliers, contractors and manufacturers for all materials and equipment which will be submitted for incorporation into the project. The list shall be arranged in accordance with the organization of the Specifications. This initial list shall include the manufacturer's name and type or catalog number as required to identify the quality of material or equipment proposed. This list will be reviewed by the Engineer and the Owner and will be returned to the Contractor with comments as to which items are acceptable without further submittal data and which items will require detailed submittal data for further review and subsequent approval. The initial list shall be submitted as herein specified. Materials and equipment requiring detailed submittal data shall be submitted with sufficient data to indicate that all requirements of these Specifications have been met and samples shall be furnished when requested. All manufacturer's data used as part of the submittal shall have all inapplicable features crossed out or deleted in a manner that will clearly indicate exactly what is to be furnished.
- C. It is not the intent of the Drawings and/or Specifications to limit products to any particular manufacturer nor to discriminate against an "APPROVED EQUAL" product as produced by another manufacturer. Some proprietary products are mentioned to set a definite standard for acceptance and to serve as a reference in comparison with other products. When a manufacturer's name appears in these Specifications, it is not to be construed that the manufacturer is unconditionally acceptable as a provider of equipment for this project. The successful manufacturer or supplier shall meet all of the provisions of the appropriate specification(s).
- D. The specified products have been used in preparing the Drawings and Specifications and thus establish minimum qualities with which substitutes must at least equal to be considered acceptable. The burden of proof of equality rests with the Contractor. The decision of the designer is final.
- E. When requested by the Architect/Engineer, the Contractor shall provide a sample of the proposed substitute item. In some cases, samples of both the specified item and the proposed item shall be provided for comparison purposes.

- F. Timeliness: The burden of timeliness in the complete cycle of submittal data, shop Drawings, and sample processing is on the Contractor. The Contractor shall allow a minimum of six (6) weeks time frame for review of each submission by the office of the design discipline involved after receipt of such submissions by that design discipline. The Contractor is responsible for allowing sufficient time in the construction schedule to cover the aforementioned cycles of data processing, including time for all resubmittal cycles on unacceptable materials, equipment, etc. covered by the data submitted. Construction delays and/or lack of timeliness in the above regard are the responsibility of the Contractor and will not be considered in any request for scheduled construction time extensions and/or additional costs to the Owner.
- G. All equipment installed on this project shall have local representation, local factory authorized service, and a local stock of repair parts.
- H. Acceptance of materials and equipment will be based on manufacturer's published data and will be tentative subject to the submission of complete shop Drawings indicating compliance with the contract documents and that adequate and acceptable clearances for entry, servicing, and maintenance will exist. Acceptance of materials and equipment under this provision shall not be construed as authorizing any deviations from the Specifications, unless the attention of the Architect/Engineer has been directed in writing to the specific deviations. Data submitted shall not contain unrelated information unless all pertinent information is properly identified.
- I. Certification: The Contractor shall carefully examine all data forwarded for approval and shall sign a certificate to the effect that the data has been carefully checked and found to be correct with respect to dimensions and available space and that the equipment complies with all requirements of the Specifications.
- J. Physical Size of Equipment: Space is critical; therefore, equipment of larger sizes than shown, even though of specified manufacturer, will not be acceptable unless it can be demonstrated that ample space exists for proper installation, operation, and maintenance.
- K. Materials and Equipment Lists: Eight (8) copies of the list of materials and equipment, the name of manufacturer, trade name, type, and catalog number shall be submitted to the Architect/Engineer. The lists shall be accompanied by eight (8) sets of pictorial and descriptive data derived from the manufacturers' catalogs, sales literature, or incorporated in the Shop Drawings.
- L. Should a substitution be accepted, and should the substitute material prove defective, or otherwise unsatisfactory for the service intended within the guarantee period, this material or equipment shall be replaced with the material or equipment specified at no additional cost to the Owner.

#### **1.10 MATERIALS AND WORKMANSHIP:**

- A. All materials, unless otherwise specified, shall be new, free from all defects, suitable for the intended use, and of the best quality of their respective kinds. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of work involved. All work shall be executed by mechanics skilled in their respective trades, and the installations shall provide a neat, precise appearance. Materials and/or equipment damaged in shipment or otherwise damaged prior to installation shall not be repaired at the job site but shall be replaced with new materials and/or equipment.

- B. The responsibility for the furnishing of the proper equipment and/or material and seeing that it is installed as intended by the manufacturer, rests entirely upon the Contractor who shall request advice and supervisory assistance from the representative of specific manufacturers during the installation.

#### **1.11 FLAME SPREAD PROPERTIES OF MATERIALS:**

- A. Materials and adhesives incorporated in this project to be installed within return air plenums shall conform to NFPA Standard 255, "Method of Test of Surface Burning Characteristics of Building Materials" and NFPA 90. The classification shall not exceed a flame spread rating of 25 for all materials, adhesives, finishes, etc., specified for each system, and shall not exceed a smoke developed rating of 50.

#### **1.12 REGULATORY REQUIREMENTS**

- A. The "Authority Having Jurisdiction" over the project described by these documents is the Owner, as an Agency of the State of Texas. As such, it is required that the installation shall meet the minimum standards prescribed in the latest editions of the following listed codes and standards, which are made a part of these Specifications. All referenced codes and standards shall be those current at the date of issue of the design documents.
- B. National Fire Protection Association Standards (NFPA):
  - 1. NFPA No. 13, Sprinkler System, Installation
  - 2. NFPA No. 14, Standpipes and Hose Systems
  - 3. NFPA No. 20, Centrifugal Fire Pumps
  - 4. NFPA No. 37, Stationary Combustion Engines & Gas Turbines
  - 5. NFPA No. 45, Fire Protection for Laboratories Using Chemicals
  - 6. NFPA No. 51, Welding & Cutting, Oxygen-Fuel Gas Systems
  - 7. NFPA No. 54, Gas Appliances, Piping, National Fuel Gas Code
  - 8. NFPA No. 70, National Electrical Code
  - 9. NFPA No. 72D, Proprietary Signaling Systems
  - 10. NFPA No. 78, Lightning Protection Code
  - 11. NFPA No. 90A, Air Conditioning Systems
  - 12. NFPA No. 91, Blower & Exhaust Systems
  - 13. NFPA No. 99, Health Care Facilities
  - 14. NFPA No. 101, Life Safety Code
  - 15. NFPA No. 200, Series, Building Construction
  - 16. NFPA No. 255, Method of Test of Surface Burning Characteristics of Building Materials



27. NFPA No. 258, Standard Research Test Method for Determining Smoke Generation of Solid Materials
- C. American National Standards Institute (ANSI):
1. A40.8, National Plumbing Code
  2. B31.1, Power Piping
  3. B9.1, Safety Code for Mechanical Refrigeration
- D. American Gas Association Publications (AGA): Directory of Approved Gas Appliances and Tested Accessories
- E. American Society of Mechanical Engineers (ASME): Boiler and Pressure Vessel Codes
- F. Air Conditioning and Refrigeration Institute Standards (ARI): All standards related to refrigeration and air conditioning equipment and piping furnished under these Specifications.
- G. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA): All current editions of applicable manuals and standards (See Sections 23 31 00.UT and 23 33 00.UT).
- H. Air Moving and Conditioning Association (AMCA): All current editions of applicable manuals and standards.
- I. American Society of Testing Materials (ASTM): All current editions of applicable manuals and standards.
- J. American Water Works Association (AWWA): All current editions of applicable manuals and standards.
- K. National Electrical Manufacturers' Association (NEMA): All current editions of applicable manuals and standards.
- L. City of Houston, Fire Department as may be applicable to construction on this site.
- M. International Building Code, (Includes the International Mechanical and International Plumbing Codes)
- N. Texas Occupational Safety Act: All applicable safety standards
- O. Occupational Safety and Health Act (OSHA)
- P. ADA and ANSI Standards: All work shall be in accord with all regulations and requirements of the Standards and Specifications for Handicapped and Disabled for the Construction of Public Buildings and Facilities in the State of Texas Usable by Physically Handicapped and Disabled persons, ANSI Standards and the requirements of the American Disabilities Act.
- Q. Texas State Fire Marshal Rules
- R. State Energy Code
- S. Refer to Specification Sections hereinafter bound for additional Codes and Standards.

- T. All materials and workmanship shall comply with all applicable state and national codes, Specifications, and industry standards. In all cases where Underwriters' Laboratories, Inc. have established standards for a particular type material, such material shall comply with these standards. Evidence of compliance shall be the UL "label" or "listing" under Re-Examination Service.
- U. The Contract Documents are intended to comply with the aforementioned rules and regulations; however, some discrepancies may occur. Where such discrepancies occur, the Contractor shall immediately notify the Architect/Engineer in writing of said discrepancies and apply for an interpretation. Should the discovery and notification occur after the execution of a contract, any additional work required for compliance with said regulations shall be paid for as covered by Division 01 of these Contract Documents, providing no work of fabrication of materials has been accomplished in a manner of noncompliance. Should the Contractor fabricate and/or install materials and/or workmanship in such a manner that does not comply with the applicable codes, rules and regulations, the Contractor who performed such work shall bear all costs arising in correcting these deficiencies to comply with said rules and regulations.

### **1.13 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS:**

- A. Storage at Site: The Contractor shall not receive material or equipment at the job site until there is suitable space provided to properly protect equipment from rust, drip, humidity, and dust damage.
- B. Capacities shall be not less than those indicated but shall be such that no component or system becomes inoperative or is damaged because of startup or other overload conditions.
- C. Conformance with Agency Requirements: Where materials or equipment are specified to be approved, listed, tested, or labeled by the Underwriters' Laboratories, Inc., or constructed and/or tested in accordance with the standards of the American Society of Mechanical Engineers or the Air Moving and Conditioning Association, the Contractor shall submit proof that the items furnished under this Section of the Specifications conform to such requirements. The label of the Underwriters Laboratories, Inc., applied to the item will be acceptable as sufficient evidence that the items conform to such requirements. The ASME stamp or the AMCA label will be acceptable as sufficient evidence that the items conform to the respective requirements.
- D. Nameplates: Each major component of equipment shall have the manufacturer's name, address, and catalog number on a plate securely attached to the item of equipment. All data on nameplates shall be legible at the time of Final Inspection.
- E. Prevention of Rust: Standard factory finish will be acceptable on equipment specified by model number; otherwise, surfaces of ferrous metal shall be given a rust inhibiting coating. The treatment shall withstand 200 hours in salt spray fog test, in accordance with Method 6061 of Federal Standard No. 141. Immediately after completion of the test, the specimen shall show no signs of wrinkling or cracking and no signs of rust creepage beyond 1/8" on either side of the scratch mark. Where rust inhibitor coating is specified hereinafter, any treatment that will pass the above test is acceptable unless a specific coating is specified except that coal tar or asphalt type coating will not be acceptable unless so stated for a specific item. Where steel is specified to be hot-dip galvanized, mill-galvanized sheet steel may be used provided all raw edges are painted with a zinc-pigmented paint conforming to Military Specification MIL-P-26915.
- F. Protection from Moving Parts: Belts, pulleys, chains, gears, couplings, projecting set screws, keys, and other rotating parts shall be fully enclosed or properly guarded for personnel protection.

- G. Verification of Dimensions: The Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and become thoroughly familiar with all details of the work and working conditions, to verify all dimensions in the field, and to advise the Architect/Engineer of any discrepancy before performing any work. Adjustments to the work required in order to facilitate a coordinated installation shall be made at no additional cost to the Owner or the Architect/Engineer.

**1.14 WALL, FLOOR AND CEILING PLATES:**

- A. See Section 23 05 29.

**1.15 SLEEVES, INSERTS, AND FASTENINGS:**

- A. See Section 23 05 29.

**1.16 PROJECT/SITE CONDITIONS**

- A. Install Work in locations shown on Drawings, unless prevented by Project conditions.
- B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Architect/Engineer before proceeding.

**1.17 MANUFACTURER'S RECOMMENDATIONS**

- A. The manufacturer's published directions shall be followed in the delivery, storage, protection, installation, piping, and wiring of all equipment and material. The Contractor shall promptly notify the Architect/Engineer, in writing, of any conflict between the requirements of the Contract Documents and the manufacturers' directions, and shall obtain the Architect/Engineer's instructions before proceeding with the work. Should the Contractor perform any such work that does not comply with the manufacturers' directions or such instructions from the Architect/Engineer, he shall bear all costs arising in connection with the deficiencies.

**1.18 SPACE AND EQUIPMENT ARRANGEMENT:**

- A. The size of mechanical and electrical equipment indicated on the Drawings is based on the dimensions of a particular manufacturer and a particular model. While other manufacturers and models may be acceptable, it is the responsibility of the Contractor to determine if the equipment he proposes to furnish will fit in the space with all adequate clearances. Fabrication Drawings shall be prepared when required by the Architect/Engineer or Owner to indicate a suitable arrangement.
- B. All equipment shall be installed in a manner to permit access to all surfaces. All valves, motors, drives, filters, and other accessory items shall be installed in a position to allow removal for service without disassembly of another part.

**1.19 LARGE APPARATUS:**

- A. Any large piece of apparatus which is to be installed in any space in the building, and which is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed. Following placement in the space, such apparatus shall be thoroughly, completely protected from damage as hereinafter specified.

## **1.20 PROTECTION:**

- A. The Contractor shall at all times take such precautions as may be necessary to properly protect all materials and equipment from damage from the time of delivery until the completion of the work. This shall include the erection of all required temporary shelters and supports to adequately protect any items stored in the open on the site from the weather, the ground and surrounding work; the cribbing of any items above the floor of the construction; and the covering of items in the incomplete building with tarpaulins or other protective covering; the installation of electric heaters in electrical switchgear and similar equipment to prevent moisture damage. Failure on the part of the Contractor to comply with the above will be sufficient cause for the rejection of the items in question.
- B. Take particular care not to damage the building structure in performing work. All finished floors, step treads, and finished surfaces shall be covered to prevent any damage by workmen or their tools and equipment during the construction of the building.
- C. Equipment and materials shall be protected from rust both before and after installation. Any equipment or materials found in a rusty condition at the time of final inspection must be cleaned of rust and repainted as specified elsewhere in these Specifications.

## **1.21 COOPERATION BETWEEN TRADES AND WITH OTHER CONTRACTORS:**

- A. Each trade, subcontractor, and/or Contractor must work in harmony with the various other trades (including Controls and Testing and Balancing), subcontractors and/or Contractors on the job as may be required to facilitate the progress to the best advantage of the job as a whole. Each trade, subcontractor, and/or Contractor must pursue its work promptly and carefully so as not to delay the general progress of the job. This Contractor shall work in harmony with Contractors working under other contracts on the premises.

## **1.22 ELECTRICAL WIRING OF MOTORS AND EQUIPMENT:**

- A. The Contractor shall note that the electrical design and Drawings are based on the equipment scheduled and indicated on the Drawings, and should any mechanical equipment be provided requiring changes to the electrical design, the required electrical changes shall be made at no cost to the Owner.
- B. The Electrical Trades shall provide all interconnecting wiring for the installation of all power. The Electrical Trades shall provide all disconnect switches as required for proper operation, as indicated on the Drawings or required by applicable code. All combination starters, individual starters, and other motor starting apparatus not specifically scheduled or specified as provided by the equipment manufacturer under the scope of Division 23, shall be provided under the scope of Division 26.
- C. The Mechanical Trades shall provide complete wiring diagrams indicating power wiring and interlock wiring. Diagrams shall be submitted to the Architect/Engineer for review within thirty (30) days after the submittals for equipment have been reviewed. Diagrams shall be based on accepted equipment and shall be complete full phase and interlock control Drawings, not a series of manufacturer's individual diagrams. After these diagrams have been reviewed by the Architect/Engineer, copies shall be transmitted to the Electrical Trades by the Contractor. They shall be followed in detail.

### 1.23 SUPERVISION:

- A. Each Contractor and subcontractor shall keep a competent superintendent or foreman on the job at all times. (Refer to the Uniform General Conditions for additional information concerning supervision.)
- B. It shall be the responsibility of each superintendent to study all Drawings and familiarize himself with the work to be done by other trades. He shall coordinate his work with other trades and before material is fabricated or installed, make sure that his work will not cause an interference with another trade. Where interferences are encountered, they shall be resolved at the job site by the superintendents involved. Where interferences cannot be resolved without major changes to the Drawings, the matter shall be referred to the A/E for ruling.

### 1.24 SITE OBSERVATION:

- A. Site observation by the Architect/Engineer is for the express purpose of verifying compliance by the Contractor with the Contract Documents, and shall not be construed as construction supervision nor indication of approval of the manner or location in which the work is being performed as being a safe practice or place.

### 1.25 PRECEDENCE OF MATERIALS

- A. The specifications determine the nature and setting of materials and equipment. The drawings establish quantities, dimensions and details.
- B. The installation precedence of materials shall be as follows. Note that if an interference is encountered, this shall guide the contractor in the determination of which trade shall be given the "Right-of-Way".

Building lines  
Structural Members  
Soil and Drain Piping  
Condensate Drains  
Vent Piping  
Supply, Return, and Outside Air Ductwork  
Exhaust Ductwork  
HVAC Water and Steam Piping  
Steam Condensate Piping  
Fire Protection Piping  
Natural Gas Piping  
Domestic Water (Cold and Hot)  
Refrigerant Piping  
Electrical Conduit

### 1.26 CONNECTIONS FOR OTHERS:

- A. The Mechanical Contractor shall rough in for and make all gas, water, steam, sewer, etc. connections to all fixtures, equipment, machinery, etc., provided by others in accordance with detailed roughing-in Drawings provided by the equipment suppliers, by actual measurements of the equipment connections, or as detailed.
- B. After the equipment is set in place, this Contractor shall make all final connections and shall provide all required pipe, fittings, valves, traps, etc.

- C. Provide all air gap fittings required, using materials hereinbefore specified. In each service line connected to an item of equipment or piece of machinery, provide a shutoff valve. On each drain not provided with a trap, provide a suitable trap.
- D. All pipe fittings, valves, traps, etc., exposed in finished areas and connected to chrome plated lines provided by others shall be chrome plated to match.
- E. Provide all sheet metal ductwork, transition pieces, etc., required for a complete installation of vent hoods, fume hoods, etc., provided by others.

#### 1.27 INSTALLATION METHODS:

- A. Where to Conceal: All pipes, conduits, etc., shall be concealed in pipe chases, walls, furred spaces, or above the ceilings of the building unless otherwise indicated.
- B. Where to Expose: In mechanical rooms, janitor's closets tight against pan soffits in exposed "Tee" structures, or storage spaces, but only where necessary, piping may be run exposed. All exposed piping shall be run in the most aesthetic, inconspicuous manner, and parallel or perpendicular to the building lines.
- C. Support: All piping, ducts and conduits shall be adequately and properly supported from the building structure by means of hanger rods or clamps to walls as herein specified.
- D. Maintaining Clearance: Where limited space is available above the ceilings below concrete beams or other deep projections, pipe and conduit shall be sleeved through the projection where it crosses, rather than hung below them in a manner to provide maximum above-floor clearance. Sleeves shall be as herein specified. Approval shall be obtained from the Architect/Engineer for each penetration.
- E. All pipe, conduits, etc., shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing. All ducts, pipes and conduits run exposed in machinery and equipment rooms shall be installed parallel to the building lines, except that piping shall be sloped to obtain the proper pitch. Piping, ducts and conduits run in furred ceilings, etc., shall be similarly installed, except as otherwise shown. Conduits in furred ceilings and in other concealed spaces shall be neatly grouped and racked indicating good workmanship. All conduit and pipe openings shall be kept closed until the systems are closed with final connections.
  - 1. All piping not directly buried in the ground shall be considered as "interior piping".
  - 2. Prior to the installation of any ceiling material, gypsum, plaster, or acoustical board, the Contractor shall notify the construction inspector so that arrangement can be made for an inspection of the above-ceiling area about to be "sealed" off. The Contractor shall give as much advance notice as possible no less than 10 working days.
  - 3. All above-ceiling areas will be subject to a formal inspection before ceiling panels are installed, or installation is otherwise concealed from view. All mechanical and electrical work at and above the ceiling, including items supported by the ceiling grid, such as air inlets or outlets and lighting fixtures, shall be complete and installed in accordance with contract requirements, including power to lighting fixtures, fans, and other powered items. Adequate lighting shall be provided to permit thorough inspection of all above-ceiling items. The inspection will include representatives of the following: General Contractor and each Subcontractor having work above the ceiling, Architect/Engineer, Physical Plant, Resident Construction Manager's Construction Inspector(s), the Resident Construction Manager and Office of Facilities Planning and

Construction (OFPC). Areas to be included and time of inspection shall be coordinated with the Construction Inspector.

4. The purpose of this inspection is to verify the completeness and quality of the installation of the air conditioning systems, the electrical systems, the plumbing systems, and any other special above ceiling systems such as pneumatic tube, vacuum systems, fire sprinkler piping and cable tray systems. The ceiling supports (tee bar or lath) shall be in place so that access panel and light fixture locations are identifiable and so that clearances and access provisions may be evaluated.
5. No ceiling materials may be installed until the resulting deficiency list from this inspection is worked off and the Construction Inspector has given approval.

#### **1.28 RECORDS FOR OWNER:**

- A. The Contractor shall maintain a set of "blue-line" prints in the Field Office for the sole purpose of recording "installed" conditions. Daily note all changes made in these Drawings in connection with the final installation including exact dimensioned locations of all new underground utilities, services and systems and all uncovered existing active and inactive piping outside the building.
- B. At Contract completion the Contractor shall provide a set of reproducible revised drawings per Division 01. The contractor shall transfer the information from the "blue-line" prints maintained as described above, and turn over this neatly marked set of reproducible Drawings representing the "as installed" work to the Architect/Engineers for verification and subsequent transmittal to the Owner. The Contractor shall refer to Division 01 of these Specifications, and to the Uniform General Conditions, for additional information. These Drawings shall include as a minimum:
  1. Addendum written drawing changes.
  2. Addendum supplementary drawings.
  3. Accurate, dimensioned locations of all underground utilities, services and systems.
  4. Identification of equipment work shown on Alternates as to whether alternates were accepted and work actually installed.
  5. Change Order written drawing changes.
  6. Change Order supplementary drawings.
- C. In addition to the above, the Contractor shall accumulate during the progress of the job the following data, in duplicate, prepared in a neat brochure or packet folder and turn over to the Architect/Engineer for review, and subsequent delivery to the Owner.
  1. All warranties and guarantees and manufacturers' directions on equipment and material covered by the Contract.
  2. Two sets of operating instructions for heating and cooling and other mechanical and electrical systems. Operating instructions shall also include recommended preventative maintenance and seasonal changeover procedures.
  3. Valve tag charts and diagrams specified herein.
  4. Approved wiring diagrams and control diagrams representing "as installed" conditions.

5. Copies of approved Shop Drawings.
  6. Any and all other data and/or drawings required as submittals during construction.
  7. Repair parts list of all major items and equipment including name, address and telephone number of local supplier or agent.
- F. All of the above data shall be submitted to the Architect/Engineer for approval, and shall be corrected as instructed by the Architect/Engineer.

#### **1.29 ACCESS DOORS:**

- A. General: This Contractor shall provide wall or ceiling access doors for unrestricted access to all concealed items of mechanical equipment or devices.
- B. Doors: Access doors mounted in painted surfaces shall be of Milcor (Inland-Ryerson Construction Products Company) manufacture, Style K for plastered surfaces and Style M or DW for non-plastered surfaces. The Style K doors shall be set so that the finished surface of the door is even with the finished surface of the adjacent finishes. Access doors mounted on tile surfaces shall be of similar construction as noted above, except they shall be of stainless steel materials. Access doors shall be a minimum of 12" x 12" in size.

#### **1.30 OPERATION PRIOR TO COMPLETION:**

- A. When any piece of mechanical equipment is operable and it is to the advantage of the Contractor to operate the equipment, he may do so, providing that he properly supervises the operation, and has the Construction Inspector's written permission to do so. The warranty period shall, however, not commence until such time as the equipment is operated for the beneficial use of the Owner, or date of substantial completion, whichever occurs first.
- B. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, install clean filter media, properly adjust, and complete all deficiency list items before final acceptance by the Owner. The date of acceptance and performance certification will be the same date.

#### **1.31 CHECKING AND TESTING MATERIALS AND/OR EQUIPMENT:**

- A. Before the work is accepted, an authorized representative of the manufacturer of the installed materials and/or equipment shall personally inspect the installation and operation of his materials and/or equipment to determine that it is properly installed and in proper operating order. The qualifications of the representative shall be appropriate to the technical requirements of the installation. The qualifications of the representative shall be submitted to the owner for approval. The decision of the owner concerning the appropriateness of the representative shall be final. Testing and checking shall be accomplished during the course of the work where required by work being concealed, and at the completion of the work otherwise. In addition, the Contractor shall submit to the Architect/Engineer a signed statement from each representative certifying as follows: "I certify that the materials and/or equipment listed below have been personally inspected by the undersigned authorized manufacturer's representative and is properly installed and operating in accordance with the manufacturer's recommendations".
- B. Check inspections shall include plumbing equipment, heating, air conditioning, insulation, ventilating equipment, controls, mechanical equipment and such other items hereinafter specified or specifically designated by the Architect/Engineer.



### **1.32 TESTS:**

- A. The Contractor shall make, at no additional cost to the Owner, any tests deemed necessary by the inspection departments having jurisdiction, and in the National Fire Protection Association, ASTM, etc. Standards listed. The Contractor shall provide all equipment, materials, and labor for making such tests. Reasonable amounts of fuel and electrical energy costs for system tests will be paid by the Owner. Fuel and electrical energy costs for system adjustment and tests which follow beneficial occupancy by the Owner will be borne by the Owner.
- B. Additional tests specified hereinafter under the various Specification Sections shall be made.
- C. The Construction Inspector shall be notified in writing at least 10 working days prior to each test and other Specification requirements requiring action on the part of the Construction Inspector. All equipment shall be placed in operation and tested for proper automatic control requirements before the balancing agency starts their work.
- D. Maintain Log of Tests as hereinafter specified.
- E. See Specifications hereinafter for additional tests and requirements.

### **1.33 LOG OF TESTS:**

- A. All tests shall have pertinent data logged by the Contractor at the time of testing. Data shall include date, time, personnel, description, and extent of system tested, test conditions, test results, specified results, and other pertinent data. Data shall be delivered to the Architect/Engineer as specified under "Requirements for Final Acceptance". All Test Log entries shall be legibly signed by the Project Contractor or his authorized job superintendent.

### **1.34 COOPERATION AND CLEANUP:**

- A. It shall be the responsibility of each trade to cooperate fully with the other trades on the job to help keep the job site in a clean and safe condition. At the end of each day's work, each trade shall properly store all of his tools, equipment and materials and shall clean his debris from the job. Upon the completion of the job, each trade shall immediately remove all of his tools, equipment, any surplus materials and all debris caused by that portion of the work.

### **1.35 CLEANING AND PAINTING:**

- A. All equipment furnished and installed in exposed areas under Divisions 23 and 26 of these Specifications shall be cleaned, prepared, and painted according to the specification for the equipment.
- B. All purchased equipment furnished by the mechanical and electrical subcontractors shall be delivered to the job with a suitable factory protective finish with the colors hereinafter specified. The following materials shall not be painted: copper, galvanized metal, stainless steel, fiberglass, PVC, and PVDF.
- C. Before painting, materials and equipment surfaces shall be thoroughly cleaned of cement, plaster, and other foreign materials, and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out. Exposed metal work shall be carefully brushed down with the steel brushes to remove rust and other spots and left smooth and clean.

- D. Color of finish painting noted shall be painted using Pratt and Lambert, Inc.'s "Effector" enamel, or approved equal. Two coats shall be applied with a light tint first coat and deep color for final coat. Colors shall be as follows:

<u>ITEM</u>	<u>COLOR</u>	<u>"P and L" PAINT NUMBER</u>
Pump Couplings and Fuel Gas Piping	Safety Yellow	Y361M (Daisy Yellow)
Fire Protection Equipment and Piping	Safety Red	R131R (Vibrant Red)

Note that the paint specified above is included for purposes of establishing a quality which shall be used on this project. The proposed paint shall be submitted, and alternatives will be considered using the submittal procedures specified in this document.

- E. Jacketing on insulation shall not be painted.
- F. No nameplates on equipment shall be painted, and suitable protection shall be afforded to the plates to prevent their being rendered illegible due to the painting operation.
- G. Scope of painting for Division 23 and 26 work in areas other than those defined as "exposed" is as follows:
1. All canvas finishes including those underfloor and in concealed spaces shall be painted with one sizing coat if not already sized, containing mildew resistant additive and Arabol adhesive prior to any other specified finish paint.
  2. All fuel piping (natural gas, LPG, etc.) and all fire protection piping shall be painted whether concealed or exposed, in all areas of the project without exception. Fuel piping shall be painted safety yellow, and fire protection piping shall be painted safety red. These "safety" colors shall be as defined by OSHA. Primer and first color coat may be omitted on piping above ceilings.
  3. If insulated, the piping shall be primed, only, prior to insulation, and the insulation jacketing shall be painted as specified for piping. The requirements of this paragraph are "primary" and have priority over any conflicting specification or instruction, should a conflict in the Construction Documents exist.
- H. The surfaces to be finish painted shall first be prepared as follows:
1. On canvas finishes pretreat as specified above. Insulated surfaces having vapor barrier jacket exposed to view shall first be painted with one (1) coat of sealer.
  2. Galvanized and black steel surfaces shall first be painted with one (1) coat of P&L galvanized metal primer. Primer may be eliminated on concealed fire and gas piping.
  3. Aluminum surfaces shall first be painted with one (1) coat of P&L zinc chromate primer. (See Section 1.51.5)
  4. Cast iron pipe shall first be primed with a "nonbleed" primer.
  5. The underside of all cast iron sinks not recessed in a cabinet are included as items to be painted in exposed areas.

- I. Where factory applied finishes are damaged in transit, storage or installation, or before final acceptance, they shall be restored to factory fresh condition by competent refinishers using the spray process.

**PART 2 PRODUCTS**

**NOT USED**

**PART 3 EXECUTION**

**NOT USED**

**END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

This Page is Intentionally Blank

## SECTION 23 05 13

### MOTORS

#### **PART 1 GENERAL**

1.00 **RELATED WORK** The following sections are to be included as if written herein:

- A. Section 23 00 00 – Basic Mechanical Requirements
- B. Section 23 05 29 – Sleeves, Flashings, Supports and Anchors
- C. Section 23 05 53 – Mechanical Identification

#### **1.01 SECTION INCLUDES**

- A. Single phase electric motors
- B. Three phase electric motors
- C. The Contractor shall provide all motors required for equipment supplied under this Division of the work

#### **1.02 RELATED WORK**

- A. Section 23 20 00 - HVAC Pumps

#### **1.03 REFERENCES**

- A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings
- B. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings
- C. ANSI/IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators
- D. ANSI/NEMA MG 1 - Motors and Generators
- E. ANSI/NFPA 70 - National Electrical Code

#### **1.04 SUBMITTALS**

- A. Submit product data under provisions of Section 23 00 00
- B. Submit test results verifying nominal efficiency and power factor for motors 1 horsepower and larger.
- C. Submit manufacturer's installation instructions under provisions of Section 23 00 00

#### **1.05 OPERATION AND MAINTENANCE DATA**

- A. Submit operation and maintenance data under provisions of Section 23 00 00
- B. Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

## **1.06 QUALIFICATIONS**

- A. Manufacturer: Company specializing in manufacture of electric motors for commercial use, and their accessories, with minimum three-years documented product development, testing, and manufacturing experience.

## **1.07 REGULATORY REQUIREMENTS**

- A. Conform to ANSI/NFPA 70.

## **1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to site under provisions of Section 23 00 00.
- B. Store and protect products under provisions of Section 23 00 00.
- C. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

## **1.09 WARRANTY**

- A. Provide five year manufacturer's warranty under provisions of Section 23 00 00.
- B. Warranty: Include coverage for motors 1 horsepower and larger.

## **PART 2 PRODUCTS**

### **2.01 GENERAL CONSTRUCTION AND REQUIREMENTS**

- A. Electrical Service: Refer to Drawing Schedules for required electrical characteristics.
- B. All Motors: Design for continuous operation in 40 degrees C environment, and for temperature rise in accordance with ANSI/NEMA MG 1 limits for insulation class, Service Factor, and motor enclosure type.
- C. Totally Enclosed Motors: Design for a service factor of 1.00 and an 80 degrees C maximum temperature rise in the same conditions.
- D. Explosion-Proof Motors: UL approved and labeled for hazard classification, with over temperature protection.
- E. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, Service Factor, Power Factor, efficiency.
- F. Electrical Connection: Conduit connection boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.
- G. Motors shall be built in accordance with the latest ANSI, IEEE, and NEMA Standards, and shall be fully coordinated with the equipment served, shall be of sizes and electrical characteristics scheduled, and of approved manufacture as described herein or of the same manufacture as

the equipment which they serve. All motors provided by the Contractor shall be of the same manufacture unless they are an integral part of the piece of equipment to which they are attached. Nameplate rating of motors shall match the characteristics scheduled.

- H. All motors shall be designed for NEMA Design B starting torque unless the driven machine requires high starting torque and shall be selected for quiet operation, free from magnetic hum.
- I. In addition, all motors shall be provided with adequately sized electrical connection box with threaded hub for attachment of flexible conduit, unless bus duct connection is indicated. Where motors are connected to driven equipment by the use of a V-belt drive, they shall be furnished with adjustable rails.
- J. Dynamic Balance shall be no greater than the vibration limits of the driven equipment as defined in Section 23 34 16.UT-3.01I for fans and Section 23 20 00 -3.01J for pumps.
- K. All motors shall be provided with all copper windings, terminal wiring, and copper or bronze lugs. AL/CU rated connectors are not allowed.

## **2.02 SINGLE PHASE POWER - SPLIT PHASE MOTORS**

- A. Starting Torque: Less than 150 percent of full load torque.
- B. Starting Current: Up to seven times full load current.
- C. Breakdown Torque: Approximately 200 percent of full load torque.
- D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, pre-lubricated sleeve or ball bearings.
- E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, pre-lubricated ball bearings.
- F. Single phase motors, in general, shall be less than 3/4 horsepower and shall be permanent split phase, capacitor start, induction run, 120 volt, 60 hertz motors with drip-proof enclosures except as hereinafter specified. These motors shall have built-in thermal overload protection with automatic reset, and shall be rated for temperature rise as hereinbefore specified for 3-phase motors.

## **2.03 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS**

- A. Starting Torque: Exceeding one fourth of full load torque.
- B. Starting Current: Up to six times full load current.
- C. Multiple Speed: Through tapped windings.
- D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, pre-lubricated sleeve or ball bearings, automatic reset overload protector.
- E. Single phase motors, in general, shall be less than 3/4 horsepower and shall be permanent split phase, capacitor start, induction run, 120 volt, 60 hertz motors. These motors shall have built-in thermal overload protection with automatic reset, and shall be rated for temperature rise as

hereinbefore specified for 3-phase motors.

#### **2.04 SINGLE PHASE POWER - CAPACITOR START MOTORS**

- A. Starting Torque: Three times full load torque.
- B. Starting Current: Less than five times full load current.
- C. Pull-up Torque: Up to 350 percent of full load torque.
- D. Breakdown Torque: Approximately 250 percent of full load torque.
- E. Motors: Capacitor in series with starting winding; capacitor-start/capacitor-run motors shall have two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
- F. Enclosures shall be of the open drip-proof type with a service factor of 1.15 and Class B insulation rated at 90 degrees C temperature rise measured above 40 degrees C room ambient condition at full load, unless otherwise noted.
- G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, pre-lubricated ball bearings.
- H. Single phase motors, in general, shall be less than 3/4 horsepower and shall be permanent split phase, capacitor start, induction run, 120 volt, 60 hertz motors. These motors shall have built-in thermal overload protection with automatic reset, and shall be rated for temperature rise as hereinbefore specified for 3-phase motors.

#### **2.05 THREE PHASE POWER - SQUIRREL CAGE MOTORS**

- A. Enclosures shall be of the open drip-proof type with a service factor of 1.15 (motor shall not run in Service Factor under normal operating conditions), and Class B insulation rated at 90 degrees C temperature rise measured above 40 degrees C room ambient condition at full load, unless otherwise noted.
- B. In general, all motors 3/4 horsepower and larger, unless smaller motors are indicated to be supplied as 3-phase, shall be 3-phase and shall be squirrel cage high efficiency induction type with standard NEMA frame sizes.
- C. Motors 1 HP and larger shall have integral frames.
- D. Starting Torque: Between one and one and one-half times full load torque.
- E. Starting Current: Six times full load current.
- F. Power Output, Locked Rotor Torque, Breakdown or Pullout Torque: NEMA Design B Characteristics.
- G. Design, Construction, Testing, and Performance: Conform to ANSI/NEMA MG 1 for Design B motors.
- H. Insulation System: NEMA Class B or better.
- I. Testing Procedure: In accordance with ANSI/IEEE 112, Test Method B. Load test motors to determine freedom from electrical or mechanical defects and compliance with performance



data. Test and balance motors to limits defined in 2.01J.

- J. Motor Frames: NEMA standard T-frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
- K. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors imbedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter; refer to Section 26 24 19 - Motor Control Centers.
- L. Bearings: Ball or roller type, double shielded with continuous grease relief to accommodate excessive pressure caused by thermal expansion or over lubrication. All motor bearings shall be factory pre-packed with a non-detergent lubricant, and shall be provided with lubrication fitting arranged to provide easy access when installed on the driven apparatus except as noted hereinafter. Permanently lubricated factory-sealed motors may be provided in fractional HP sizes only where they are an integral part of a piece of approved apparatus. All bearings shall be designed for L-10, 200,000 hour minimum life hours of continuous service. Calculate bearing load with NEMA minimum V- belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- M. Sound Power Levels: Refer to ANSI/NEMA MG 1.
- N. Part Winding Start [Where Indicated:] [Above 254T Frame Size:] Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.
- O. Weatherproof Epoxy [Sealed] [Treated] Motors (Where Indicated): Epoxy [seal windings using vacuum and pressure] [coat windings] with rotor and starter surfaces protected with epoxy enamel. Bearings shall be double shielded with waterproof non-washing grease.
- P. Nominal Efficiency: Meet or exceed values per 23 05 13-3.03 at full load and rated voltage when tested in accordance with ANSI/IEEE 112.
- Q. Service Factor: Meet or exceed values per 23 05 13-3.02—at full load and rated voltage when tested in accordance with ANSI/IEEE 112.
- R. Motors 1 HP and larger shall be provided with a copper frame grounding lug of hydraulic compression design, for installation by the electrical subcontractor.
- S. Motors 10hp and larger shall be inverter duty rated and shall be provided with shaft grounding device.

## **2.06 STARTING EQUIPMENT:**

- A. Each motor shall be provided with proper starting equipment. This equipment, unless hereinafter specified or scheduled to the contrary, shall be provided by the trade furnishing the motor. All motor starting equipment provided by any one trade shall be of the same manufacture unless such starting equipment is an integral part of the equipment on which the motor is mounted. The Mechanical Subcontractor shall furnish all starters for Division 23 work, except those starters scheduled to be provided in Division 26 Motor Control Centers.
- B. Motor starters shall conform to NEMA Standards for Industrial Control, #IC-1, latest issue, and shall be housed in NEMA Standard enclosures. Control voltage in each starter shall be not more than 120 volts to ground, with an individual control transformer provided in each starter as required. Manual starters for fractional horsepower single-phase motors shall be on-off or snap

switch type combined with thermal overload device. The switch shall be so constructed so that it cannot be held closed under a sustained motor overload.

- C. Magnetic starters shall have thermal overload protection in each of the ungrounded legs and shall be solenoid operated. Provide the correct size heater element to protect the motor and allow it to operate based on motor nameplate amperes and ambient temperatures anticipated for each individual motor. Each starter shall be provided with a control power transformer or 120v control power circuit.
- D. Pushbuttons with or without pilot lights, hand-off-automatic switches and other scheduled apparatus shall be standard duty type mounted in NEMA enclosures or in cover of starter as specified or scheduled, and shall be furnished by the trade furnishing the starter except as specifically indicated elsewhere.
- E. Hand-Off-Automatic switches for equipment which could damage itself if left in the "hand" position (such as sump pumps), shall be spring return to "off" from the "hand" position.

**PART 3 EXECUTION**

**3.01 APPLICATION**

- A. Motors drawing less than 250 Watts and intended for intermittent service may be germane to equipment manufacturer and need not conform to these specifications.
- B. Motors shall be open drip-proof type, except where specifically noted otherwise.
- C. Motors shall be energy efficient type.
- D. Single phase motors for centrifugal pumps shall be split phase type.
- E. Single phase motors for shaft mounted fans or blowers shall be permanent split capacitor type.
- F. Single phase motors for pumps shall be capacitor start type.
- G. Single phase motors for pumps shall be capacitor start, capacitor run type.

**3.02 NEMA OPEN MOTOR SERVICE FACTORS**

HP	3600 RPM	1800 RPM	1200 RPM	900 RPM
1/6-1/3	1.35	1.35	1.35	1.35
1/2	1.25	1.25	1.25	1.15
3/4	1.25	1.25	1.15	1.15
1	1.25	1.15	1.15	1.15
1.5-150	1.15	1.15	1.15	1.15

**3.03 Motor Efficiencies\* – Nominal, full load, three phase**

	Open Drip-Proof (ODP)			Totally Enclosed Fan-Cooled (TEFC)		
	1200 RPM	1800 RPM	3600 RPM	1200 RPM	1800 RPM	3600 RPM
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.8
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7
40	94.1	94.1	92.4	94.1	94.1	92.4
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.0	93.6	94.5	95.4	93.6
100	95.0	95.4	93.6	95.0	95.4	94.1
125	95.0	95.4	94.1	95.0	95.4	95.0
150	95.4	95.8	94.1	95.8	95.8	95.0
200	95.4	95.8	95.0	95.8	96.2	95.4

\*Reference NEMA MG 1-2006 Table 12-12.

**END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

This Page is Intentionally Blank

## SECTION 23 05 29

### SLEEVES, FLASHINGS, SUPPORTS AND ANCHORS

#### PART 1 GENERAL

##### 1.0 RELATED WORK The following sections are to be included as if written herein:

- A. Section 23 00 00 – Basic Mechanical Requirements
- B. Section 23 05 53 – Mechanical Identification

##### 1.01 SECTION INCLUDES

- A. Pipe and equipment hangers and supports
- B. Sleeves and seals

##### 1.02 RELATED SECTIONS

- A. Section 23 07 16 - Ductwork Insulation

##### 1.03 REFERENCES

- A. ASME B31.9 - Building Services Piping
- B. ASTM F708 - Design and Installation of Rigid Pipe Hangers
- C. MSS SP69 - Pipe Hangers and Supports - Materials, Design and Manufacturer
- D. MSS SP89 - Pipe Hangers and Supports - Selection and Application
- E. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices
- F. NFPA 13 - Installation of Sprinkler Systems
- G. UL 203 - Pipe Hanger Equipment for Fire Protection Service

##### 1.04 SUBMITTALS

- A. Submit under provisions of Section 23 00 00.
- B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
- C. Product Data: Provide manufacturers catalog data including load capacity.
- D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- E. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

## **1.05 REGULATORY REQUIREMENTS**

- A. Conform to applicable code for support of plumbing, hydronic, steam and steam condensate piping.
- B. Supports for Sprinkler Piping: Shall be in conformance with NFPA 13.
- C. Supports for Standpipes: Shall be in conformance with NFPA 14.

## **PART 2 PRODUCTS**

### **2.01 HANGERS AND SUPPORTS**

- A. Manufacturers:
  - 1. Grinnell.
  - 2. Kindorf
  - 3. B-Line
  - 4. Power Strut
  - 5. Anvil International
- B. Supports, hangers, anchors and guides shall be provided for all horizontal and vertical piping. Shop Drawings shall be provided, indicating locations and details of anchors, guides, expansion loops and joints, hangers, etc. The hanger design shall conform to the ASME Code for Pressure Piping.
- C. All auxiliary steel required for supports, anchors, guides, etc. shall be provided by the Mechanical Trades unless specifically indicated to be provided by others.
- D. The supports, hangers, anchors, and guides for the chilled water supply and return piping, steam piping, condensate return piping, etc. of the Campus Loop System routed above covered walk shall be provided as indicated on the Drawings.
- E. Contractor shall review all Drawings, including Structural Drawings, for details regarding pipe supports, anchors, hangers, and guides.
- F. All Supports shall be of type and arrangement to prevent excessive deflection, to avoid excessive bending stresses between supports, and to eliminate transmission of vibration.
- G. All rod sizes indicated in this Specification are minimum sizes only. This trade shall be responsible for structural integrity of all supports, anchors, guides, etc. All structural hanging materials shall have a minimum safety factor of 5 built in.
- H. Anchor points as indicated on Drawings or as required shall be located and constructed to permit the piping system to take up its expansion and contraction freely in opposite directions away from the anchored points.

- I. Guide points shall be located and constructed wherever required or indicated on Drawings and at each side of an expansion joint or loop, to permit free axial movement only.
- J. Supports, hangers, anchors, and guides shall be fastened to the structure only at such points where the structure is capable of restraining the forces in the piping system.
- K. Other special type of hangers may be employed where so specified or indicated on the Drawings, or where required by the particular conditions. In any case, all hangers must be acceptable to the owner.
- L. All electrical conduits shall be run parallel or perpendicular to adjacent building lines. Single conduits running horizontally shall be supported by "Caddy" or "Minerallac" type hangers from adequately sized rods (minimum 1/4") from the building structure. Where multiple conduits are run horizontally, they shall be supported on trapeze of "Unistrut" type channel suspended on rods or bolted to vertical building members. Conduit shall be secured to channel with galvanized "Unistrut" type conduit clamps or stainless steel "Unistrut" type "Uni-Clips." All hangers shall be fastened to the building structure in the same manner as specified above for pipe hangers. Spacing of hangers shall be adequate for the weight and rigidity of the conduits involved; in any case, no greater than 8' centers. Where feasible, conduits may be fastened to the concrete by one-hole straps thoroughly anchored to the concrete in an approved manner. Flexible conduit shall also be supported in an acceptable manner so as not to interfere with the maintenance of above-ceiling equipment, and to support it from touching the ceiling system. Conduit shall be located so as not to inhibit removal of ceiling tiles.
- M. Vertical conduits shall be supported as often as necessary for rigidity by clamps resting on adjacent beams or floor slabs, using a minimum of one support per floor.
- N. Perforated strap iron or wire will not, under any circumstances, be acceptable as hanger material.
- O. Where specifically noted on the drawings that one material is to be hung from the support of another material due to space restrictions, the hangers shall be sized to properly carry the weight of all items to be supported by such.
- P. Vibration Isolation: Resilient hangers shall be provided on all piping connected to rotating equipment (pumps, etc.). Piping or ductwork that may vibrate and create an audible noise shall also be isolated. Spring hangers or supports shall be provided where indicated on the Drawings and/or specified under Section 23 05 48.
- Q. Attachment:
  - 1. The load and spacing on each hanger and/or insert shall not exceed the safe allowable load for any component of the support system, including the concrete which holds the inserts. Reinforcement at inserts shall be provided as required to develop the strength required.
  - 2. Inserts shall be of a type which will not interfere with reinforcing as shown on the structural Drawings and which will not displace excessive amounts of structural concrete.
  - 3. All supports shall be designed and installed to avoid interference with other piping, hangers, ducts, electrical conduit, supports, building structures, equipment, etc. All piping shall be

installed with due regard to expansion and contraction and the type of hanger method of support, location of support, etc. shall be governed in part by this Specification.

4. Hangers shall be attached to the structure as follows:
  - a) **Poured In Place Concrete:** Where pipes and equipment are supported under poured in place concrete construction, each hanger rod shall be fitted with a nut at its upper end, which nut shall be set into an Underwriters Laboratories, Inc. listed universal concrete insert placed in the form work before concrete is poured. Where inserts are placed in the bottom faces of concrete joists which are too narrow to provide adequate strength of concrete to hold the insert properly or where a larger insert would require displacement of the bottom joist steel, the hanger rod shall be suspended from the center of a horizontal angle iron, channel iron, I-beam, etc. spanning across two adjacent joists. The horizontal support shall be bolted to nonadjustable concrete inserts of the "spot" type, of physical size small enough to avoid the bottom joist steel.
  - b) **Steel Bar Joists:** Where pipes and loads are supported under bar joists, hanger rods may be run through the space between the bottom angles and secured with a washer and two nuts. Where larger lines are supported beneath bar joists, hanger rods shall be secured to angle irons of adequate size; each angle shall span across two or more joists as required to distribute the weight properly and shall be welded to the joists or otherwise permanently fixed thereto.
  - c) **Steel Beams:** Where pipes and loads are supported under steel beams, approved type beam clamps shall be used.
  - d) **Pre-Cast Tee Structural Concrete:** Hanger supports, anchors, etc. required for mechanical systems attached to the precast, double tee, structural concrete system are to be installed in accord with approved shop Drawings only. Holes required for hanger rods shall be core drilled in the "flange" of the double tee only; impact type tools are not allowed under any circumstances. Core drilling in the "stem" portions of the double tee is not allowed. Holes core drilled through the "flange" for hanger rods shall be no greater than 1/4" larger than the diameter of the hanger rod. Hanger rods shall be supported by means of bearing plates of size and shape acceptable to the Architect/Engineer, with welded double nuts on the hanger rod above the bearing plate. Cinch anchors, lead shields, expansion bolts, and studs driven by explosion charges are not allowed under any circumstances in the lower 15" of each stem and in the "shadow" of the stem on the top side of the "double tees."
  - e) If it is necessary to install a method of fastening a hanger after the structure has been installed, then only clamps or drilled anchors shall be used.

Power-actuated fasteners (shooting) will not be acceptable under any circumstances.

Note: Under no circumstances will the use of plastic anchors or plastic expansion shields be permitted for any purpose whatsoever.

5. Power-actuated fasteners (shooting) will not be acceptable under any circumstances.



- R. Finishes: All hangers on piping including clevis hangers, rods, inserts, clamps, stanchions, and brackets, shall be dipped in Zinc Chromate Primer before installation. Rods may be galvanized or cadmium plated after threading, in lieu of dipping zinc chromate. Universal concrete inserts shall be cadmium plated.
- S. Trapezes: Where multiple lines are run horizontally at the same elevation and grade, they may be supported on trapezes of Kindorf, Uni-Strut, Power Strut, or approved equal, channel-suspended on rods or pipes. Trapeze members including suspension rods shall each be properly sized for the number, size, and loaded weight of the lines they are to support.
- T. Miscellaneous: Provide any other special foundations, hangers and supports indicated on the Drawings, specified elsewhere herein; or required by conditions at the site. Hangers and supporting structures for suspended equipment shall be provided as required to support the load from the building structure in a manner acceptable to the Architect/Engineer.
- U. Miscellaneous: Provide any other special foundations, hangers and supports indicated on the Drawings, specified elsewhere herein; or required by conditions at the site. Hangers and supporting structures for suspended equipment shall be provided as required to support the load from the building structure in a manner acceptable to the Architect/Engineer.
- V. Ductwork supported from the floor: Ductwork supported from the floor shall be done by the same means as that supported from above, but shall include a neoprene vibration isolation spacer to restrict vibration transmission to the structure below.

### **2.03 ACCESSORIES**

- A. Hanger Rods: Galvanized mild steel threaded both ends, galvanized threaded one end, or galvanized continuous threaded.
- B. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods. Suitable concrete inserts for pipe and equipment hangers shall be set and properly located for all pipe and equipment to be suspended from concrete construction. If the inserts are later found not to be in the proper location for the placement of hangers, then drilled anchors shall be installed. Drilled anchors in concrete or masonry shall be submitted for the approval by the Owner.

### **2.04 WALL, FLOOR AND CEILING PLATES:**

- A. Except as otherwise noted, provide C.P. (Chrome plated) brass floor and ceiling plates around all pipes, conduits, etc., passing exposed through walls, floors, or ceilings, in any spaces except underfloor and attic spaces. Plates shall be sized to fit snugly against the outside of the pipe or against the insulation on lines which are insulated and positively secured to such pipe or insulation. Plates will not be required for piping where pipe sleeves extend 3/4" above finished floor. All equipment rooms are classified as finished areas. Round and rectangular ducts shall have closure plates (NOT chrome plated) made to fit accurately at all floor, wall and ceiling penetrations. Floor penetrations in exposed (except in stair wells) areas shall be finished using 'bell' fitting to fit pipe or insulation and sleeve and shall be painted to match the pipe. Penetrations in stairwells shall have flat floor plate painted to match pipe.

## 2.05 SLEEVES

- A. General: All openings through all floors, walls, and roofs, etc., regardless of material for the passage of piping, ductwork, conduit, cable trays, etc., shall be sleeved. All penetrations must pass through sleeves. Sleeves shall be set in new construction before concrete is poured, as cutting holes through any part of the concrete will not be permitted unless acceptable to the Architect/Engineer. If a penetration is cored into an existing vertical solid concrete, masonry or stone structure, then the installation of a sleeve will not be necessary.
1. Sleeve material for floors and exterior walls shall be Schedule 40 galvanized steel with welded water stop rings.
  2. Sleeves through interior walls to be galvanized sheetmetal with gauge as required by wall fire rating, 20 gauge minimum.
- B. The minimum clearance between horizontal penetrations including insulation where applicable, and sleeve shall be 1/4", except that the minimum clearance shall accommodate a Thunderline Link-seal closure where piping exits the building, or penetrates a wall below ground level. Contractor shall be responsible for the accurate location of penetrations in the slab for his pipe, duct, etc. All penetrations shall be of ample size to accommodate the pipe, duct, etc., plus any specified insulation. Void between sleeve and pipe in interior penetrations shall be filled with Nelson Flameseal Firestop or approved equal caulk or putty.
- C. Floor sleeves shall extend above the finished floor as detailed on the drawings, except that floor sleeves in stairwells shall be flush with the finished floor. Sleeves in walls shall be trimmed flush with wall surface. Refer to the details on the project drawings. Where the details differ from these specifications, the drawings take precedence.
- D. Sleeves for penetrations passing through walls or floors on or below grade shall be removed, if practical, and after the pipes have been installed, the void space around the pipe shall be caulked with a suitable material to effect a waterproof penetration. Note that the practicality of the removal of the sleeve shall be the decision of the Construction Inspector. The decision of the Inspector shall be final.
- E. Vermin proofing: The open space around all ductwork, piping, etc., passing through the ground floor and/or exterior walls shall be vermin proofed in a manner acceptable to the Architect/Engineer.
- F. Waterproofing: The annular space between a pipe and its sleeve in interior floors shall be filled with polyurethane foam rods 50 percent greater in diameter than the space as backing and fill material and made watertight with a permanent elastic polysulfide compound. Seal both surfaces of floor.
- G. Air Plenums: The space around piping, ductwork, etc., passing through air plenums shall be made airtight in a manner acceptable to the Architect/Engineer.
- H. Fireproofing: Seal all cable trays, pipe, conduit, duct, etc., penetrations through roof, fire rated walls and floors with a foam or sealant as described below, that will form a watertight, vermin tight barrier that is capable of containing smoke and fire up to 2000° F for two hours. Sealing of cable trays and conduits that extend through rated walls from ends of cable tray shall be done after conductors have been installed. For wet locations, the foam material shall be a silicone

RTV foam or an approved equal. For dry locations, a premixed putty equal to Nelson Flameseal Firestop putty may be used.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.

### **3.02 INSERTS**

- A. Provide inserts for placement in concrete formwork.
- 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 over 4 inches.
- 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.

### **3.03 SLEEVES**

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- C. Extend sleeves through floors (except in stairwells) two inches above finished floor level. Sleeves through floors shall have welded waterstop rings. Sleeves shall be sealed watertight to floors and pipe.
- D. Where piping, ductwork or conduit penetrates floor, ceiling, or wall, close space between pipe or duct and adjacent work with fire stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers, as appropriate, at both sides of penetration.
- E. Install chrome plated steel or stainless steel escutcheons at finished surfaces.

### **3.04 LOW PRESSURE DUCT SUPPORT SCHEDULE:**

- A. All horizontal ducts up to and including 40 inches in their greater dimension shall be supported by means of No. 18 U.S. gauge band iron hangers attached to the ducts by means of screws, rivets, or clamps and fastened to above inserts with toggle bolts, beam clamps or other approved means. Duct shall have at least one pair of supports 8' 0" on centers. Clamps shall be used to fasten hangers to reinforcing on sealed ducts.
- B. Horizontal ducts larger than 40 inches in their greatest dimension shall be supported by means of hanger rods bolted to angle iron trapeze hangers. Duct shall have at least one pair of supports 8' 0" on centers according to the following:

<u>Angle Length</u>	<u>Angle</u>	<u>Rod Diameter</u>
4' 0"	1-1/2" x 1-1/2" x 1/8"	1/4"
6' 0"	1-1/2" x 1-1/2" x 1/8"	1/4"
8' 0"	2" x 2" x 1/8"	5/16"
10' 0"	3" x 3" x 1/8"	3/8"

- C. Vertical ducts shall be supported where they pass through the floor lines with 1-1/2" x 1-1/2" x 1/4" angles for ducts up to 60." Above 60", the angles must be increased in strength and sized on an individual basis considering space requirements.

<u>Angle Length</u>	<u>Angle</u>	<u>Rod Dia.</u>
4'-0"	1-1/2" x 1-1/2" x 1/8"	1/4"
6'-0"	1-1/2" x 1-1/2" x 1/8"	1/4"
8'-0"	2" x 2" x 1/8"	5/16"
10'-0"	3" x 3" x 1/8"	3/8"

- D. Vertical ducts shall be supported where they pass through the floor lines with 1-1/2" x 1-1/2" x 1/4" angles for ducts up to 60". Above 60", the angles must be increased in strength and sized on an individual basis considering space requirements.

### 3.05 DUCT HANGERS - GENERAL NOTES (all pressures)

- A. Hanger straps on duct width of 60 inches and under shall lap under the duct a minimum of 1 inch and have minimum of one fastening screw on the bottom and two on the side.
- B. Hanger straps on duct widths over 60 inches shall be bolted to duct reinforcing with 3/8" bolts minimum.
- C. Use 3/8" minimum bolts for securing duct hanger to band straps.
- D. All round ducts shall be supported within 3 feet of all horizontal or vertical turns.

#### END OF SECTION

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

## SECTION 23 05 48

### VIBRATION ISOLATION

#### **PART 1 GENERAL**

##### **1.00 RELATED WORK** The following sections are to be included as if written herein:

- A. 23 00 00 -- Basic Mechanical Requirements
- B. 23 05 29 -- Sleeves, Flashings, Supports and Anchors
- C. 23 05 53 -- Mechanical Identification

##### **1.01 WORK INCLUDED**

- A. Inertia bases
- B. Vibration isolation

##### **1.02 SCOPE OF WORK:**

- A. Furnish and install all labor, materials, equipment tools and service and perform all operations required in connection with or properly incidental to the construction of complete system of vibration and noise control, as indicated on the Drawings, reasonably implied therefrom or as specified herein, unless specifically excluded.

##### **1.03 REFERENCES**

- A. ASHRAE - Guide to Average Noise Criteria Curves

##### **1.04 QUALITY ASSURANCE**

- A. Maintain ASHRAE criteria for average noise criteria curves for all equipment at full load condition

##### **1.05 SUBMITTALS**

- A. Submit shop drawings and product data under provisions of Section 23 00 00.
- B. Indicate inertia bases on shop drawings.
- C. Indicate vibration isolator locations, with static and dynamic load on each, on shop drawings and described on product data.
- D. Submit manufacturer's installation instructions under provisions of Section 23 00 00.

##### **1.06 CERTIFICATES**

- A. Submit a certificate from the manufacturer that isolators are properly installed and properly adjusted to meet or exceed specified requirements.

## 1.07 INTENT OF RESPONSIBILITY:

- A. It is the intent of this specification to provide for vibration isolation supports for all equipment, piping, and ductwork as set out below. The transmission of perceptible vibration, structural borne noise, or objectionable air borne noise to occupied areas by equipment installed under this contract will not be permitted. The Contractor shall be held responsible for installing the vibration isolators as specified herein or shown on the drawings or otherwise required to prevent the transmission of vibration which would create objectionable noise levels in occupied areas. The isolation supplier must be a firm capable of dealing effectively with vibration and noise characteristics effects and criteria, and one which can provide facilities and capabilities for measuring and evaluating the aforementioned disturbances.
- B. All vibration isolation devices, including auxiliary steel bases and pouring forms, shall be designed and furnished by a single manufacturer or supplier who will be responsible for adequate coordination of all phases of this work. Concrete housekeeping pads and inertia bases shall be included as part of mechanical work. Pads under electrical gear shall be included as part of electrical work. The concrete work shall meet the requirements specified in the General Contract Specifications.
- C. The Contractor shall furnish complete submittal data, including Shop Drawings, which shall indicate the size, type, and deflection of each isolator; and the supported weight, disturbing frequency, and efficiency of each isolator proposed; and any other information as may be required for the Architects and Engineers to check the isolator selection for compliance with the specification. All steel bases and concrete inertia bases shall be completely detailed, and shall show completely any reinforcing steel that may be required to provide a rigid base for the isolated equipment. Further, the submittal data shall indicate, clearly, outlined procedures for installing and adjusting the isolators and bases mentioned above.
- D. The vibration isolation manufacturer, or his qualified representative, shall be responsible for providing such supervision as may be required to assure correct and complete installation and adjustment of the isolators. Upon completion of the installation and after the system is put into operation and before acceptance by the Owner, the isolation manufacturer or his qualified representative, in company with the Architect or his designated representative, shall make a final inspection and submit his report to the Architects and Engineers, in writing, certifying the correctness of the installation and compliance with approved submittal data. Any discrepancies or maladjustments found shall be so noted in the report. Should any noise or vibration be objectionable to the Owner, Architect or Engineer, a field instrumentation test and measurement must be made to determine the source, cause, and path of any such disturbance. Any variation or noncompliance with these specification requirements is to be corrected by the installing contractor in an approved manner.
- E. Vibration isolation devices shall be as manufactured by Amber/Booth Company, Consolidated Kinetics, Korfund Dynamics Corporation, or approved equal.

## PART 2 PRODUCTS

### 2.01 GENERAL DESIGN FEATURES:

- A. All vibration isolators and bases furnished by the Contractor shall be designed for and treated for resistance to corrosion.
- B. Steel components shall be PVC coated or phosphated and painted with industrial grade enamel.

All nuts, bolts and washers shall be zinc-electroplated or cad-plated. Structural bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer. A finish coat of industrial grade enamel shall be applied over the primer.

- C. All isolators exposed to the weather shall have steel parts PVC coated, hot-dip galvanized or zinc-electroplated plus coating of Neoprene or Bitumastic paint. Aluminum components for outdoor installation shall be etched and painted with industrial grade enamel.
- D. Required spring deflections for isolators supporting various items of equipment are shown on the Drawings or tabulated elsewhere in these specifications, but in no case shall be less than one inch. The springs shall be capable of 30% over-travel before becoming solid.
- E. Where height-saving brackets for side mounting of isolators are required, the height-saving brackets shall be designed to provide for an operating clearance of 2" under the isolated structure, and designed so that the isolators can be installed and removed when the operating clearance is 2" or less. When used with spring isolators having a deflection of 2-1/2" or more, the height-saving brackets shall be of the pre-compression type to limit exposed bolt length between the top of the isolator and the underneath side of the bracket.
- F. All isolators supporting a given piece of equipment shall limit the length of the exposed adjustment bolt between the top and base to a maximum range of 1" to 2".
- G. All isolators supporting a given piece of equipment shall be selected for approximately equal spring deflection.
- H. Isolators for equipment installed out-of-doors shall be designed to provide adequate restraint due to normal wind conditions and to withstand wind load of 55 PSF (pounds per square foot) applied to any exposed surface of the equipment without failure.

**2.02 ISOLATOR TYPES:** Isolator types and required deflections are specified under "Schedule of Isolated Equipment," paragraph 3.02. The isolators shall comply with the following descriptions for each type required on the project:

- A. Type 5 - A spring hanger consisting of a rectangular steel box, coil springs, spring cups, Neoprene impregnated fabric washer, steel washer, and Neoprene insert designed to prevent metal to metal contact between the hanger rod and bottom of the hanger box. The hanger box shall be capable of supporting a load of 200% of rated load without noticeable deformation or failure.
- B. Type 6 - A spring hanger, as described in Type 5, with the addition of an elastomeric element at the top of the box for acoustic isolation. The design shall be such to prevent metal - to metal contact between the hanger rod and the top of the hanger box. The elastomeric element shall meet the design requirements for Type 3 mountings.
- C. Type 7 - An elastomeric hanger, consisting of a rectangular steel box and an elastomeric isolation element, which shall be of Neoprene or high quality synthetic rubber with anti-ozone and anti-oxidant additive. The elements shall be so designed for approximately 1/4" deflection and loaded so that deflection does not exceed 15% of the free height of the element. The design shall be such as to prevent metal-to-metal contact between the hanger rod and the steel box.
- D. Type 8 - 1/4" thick closed cell Neoprene ASTM Grade S.E.C. 44 in sheets cut to fit penetrations,

as required.

### **PART 3 EXECUTION**

#### **3.01 GENERAL INSTALLATION REQUIREMENTS:**

- A. Install vibration isolators for motor driven equipment.
- B. Provide spring isolators on piping connected to isolated equipment as follows: Up to 4 inch diameter, first three points of support; 5 to 8 inch diameter, first four points of support; 10 inch diameter and over, first six points of support. Static deflection of first point shall be twice deflection of isolated equipment.
- D. Pumps:
  - 1. Each in-line centrifugal pump and its driving motor shall be isolated with the piping system they serve.
- E. Piping:
  - 1. Floor mounted supports shall have the same type of isolator or media as is used for the nearest isolated equipment connected to the piping.
  - 2. The pipe hanger system shall have provisions for all piping to be shimmed or blocked in place until all connections are made and the system filled with water; then, the isolators adjusted to support the weights, and the shim blocks removed.
  - 3. The first three support points from a piece of isolated equipment shall be of the positioning type and provide not less than the static deflection of the equipment isolators.
  - 4. All springs supporting piping shall be capable of an additional 1/2" deflection prior to complete compression and springs supporting vertical risers shall have provisions for limit stops.
- F. Resilient Sleeves:
  - 1. Resilient sleeves shall be provided at all points where equipment room walls, floors, or ceilings are penetrated by ducts, piping, or refrigerant line, etc.

#### **END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068



## **SECTION 23 05 53**

### **MECHANICAL IDENTIFICATION**

#### **PART 1 GENERAL**

1.00 The following sections are to be included as if written herein:

- A. Section 23 00 00 – Basic Mechanical Requirements
- B. Section 23 05 29 – Sleeves, Flashings, Supports and Anchors

#### **1.01 SECTION INCLUDES**

- A. Nameplates
- B. Tags
- C. Stencils
- D. Pipe Markers

#### **1.02 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION**

- A. Section 22 63 13 - Medical Gas Systems: Supply of pipe labels for placement by this Section

#### **1.03 RELATED SECTIONS**

- A. Section 09 91 00 - Painting: Identification painting

#### **1.04 REFERENCES**

- A. ASME A13.1 - Scheme for the Identification of Piping Systems

#### **1.05 SUBMITTALS**

- A. Submit under provisions of Section 23 00 00.
- B. Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Product Data: Provide manufacturers catalog literature for each product required.
- E. Samples: Submit two of each type of label, tag, etc., of the approximate size specified or implied in the specification.
- F. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

**1.06 PROJECT RECORD DOCUMENTS**

- A. Submit under provisions of Section 23 00 00.
- B. Record actual locations of tagged valves.

**PART 2 PRODUCTS**

**2.01 NAMEPLATES**

- A. Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

**2.02 TAGS**

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch (40 mm) diameter.
- B. Chart: Typewritten letter size list in anodized aluminum frame.

**2.03 PIPE MARKERS**

- A. Color: Conform to ASME A13.1.
- B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- D. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches (150 mm) wide by 4 mil (0.10 mm) thick, manufactured for direct burial service.

**2.04 CEILING TACKS**

- A. Description: Steel with 3/4 inch (20 mm) diameter color coded head.
- DC. Color code as follows:
  - 1. Yellow - HVAC equipment
  - 2. Red - Fire dampers/smoke dampers
  - 3. Green - Plumbing valves
  - 4. Blue - Heating/cooling valves

- 2.05 General: The Contractor shall make it possible for the personnel operating and maintaining the equipment and systems in this project to readily identify the various pieces of equipment, valves,

piping, etc., by marking them. All items of equipment such as fans, pumps, etc., shall be clearly marked using engraved nameplates as hereinafter specified. The item of equipment shall indicate the same number as shown on the Drawings. For example, pumps will be identified as 3A, 3B, 3C, etc.; exhaust fans will be E-1, E-2, etc.; supply fans will be S-1, S-2, etc.

- 2.06 Mechanical: All items of mechanical equipment shall be identified by the attachment of engraved nameplates constructed from laminated phenolic plastic, at least 1/16" thick, 3-ply, with black surfaces and white core. Engraving shall be condensed Gothic, at least 1/2" high, appropriately spaced. Nomenclature on the label shall include the name of the item, its mark number, area, space, or equipment served, and other pertinent information. Equipment to be labeled shall include but not be limited to the following:

Pumps

HVAC Terminal Units

Air Conditioning Control Panels and Switches

Miscellaneous – similar and/or related items

- 2.07 Piping: Pipe markers and arrow markers also shall be provided on but not limited to the piping of the following systems:

Building Chilled Water Supply

Building Chilled Water Return

Equipment Chilled Water Supply

Equipment Chilled Water Supply

Laboratory Air

Domestic Hot Water Supply

Domestic Hot Water Return

Domestic Cold Water Supply

Domestic Cold Water Return

- 2.08 Electrical: Nameplates shall be 2 or 3 ply laminated plastic, a minimum of 3/32" thick, such that letters will be white on black background. Letters shall be similar to Roman Gothic of a size that is legible and appropriate to the application. Attachment of nameplates shall be by screws. Rivets or adhesives are not acceptable.

- A. Electrical equipment to be identified includes: All switchgear, distribution panels, transformers, motor control centers, panel boards, disconnect switches, starters, contactors and time switches.
- B. Nameplates on distribution panels, motor control centers and panel boards shall give voltage

characteristics.

Example:

PANEL LA  
120/208V, 3 PH, 4 W  
served from .

- C. Individual circuit breakers in distribution panels, individual units in motor control centers, disconnecting means, and motor starters, shall have nameplates showing the load served.
  - D. Branch circuit panel boards shall have neatly typed circuit directories behind clean plastic. Identify circuits by room numbers. Room numbers shall be those finally selected by the Owner, not necessarily those given on contract Drawings. If a circuit serves more than one room, list each room. Spares and spaces shall be indicated with erasable pencil, not typed.
- 2.09 The Contractor shall prepare and install, in a suitable glazed frame, typewritten valve charts giving the number, location and function of each line valve installed under this Contract. Each valve shall be numbered on these charts in accordance with the system of which it is a part of its location. For example, valves in different systems would be designated as follows:
- |                              |                         |
|------------------------------|-------------------------|
| HPS-1-3 High Pressure Steam  | 1st Level - Valve No. 3 |
| CHS-2-4 Chilled Water Supply | 2nd Level - Valve No. 4 |
- 2.10 Valve Tags:
- A. The Contractor shall provide and install identification tags lettered and numbered to correspond to the information shown on the charts described above. These tags are to be affixed to all valves except simple service and drain valves located within 10' and within sight of the device or equipment served. For example, it would not be expected that valves at a pressure reducing station in a machine room would be tagged. These tags shall be 1/8" thick brass discs, 1 1/2" in diameter. Each tag shall be attached to its valve with copper clad annealed iron wire or other approved material.
  - B. Valves at water headers and steam PRV stations, valves associated with condensate, gas, water meters, and other valves as specified shall also be tagged with standardized color coded plastic tags. These tags shall be 2 1/2" wide by 1 1/2" high with these color codings: Red = normally closed; Green = normally open; Blue = open in winter, closed in summer; and Yellow = closed in winter, open in summer. Tags should be engraved on both sides.
- 2.11 In addition, pipe runs throughout the building including those above lift out ceilings, under floor, and those exposed to view when access doors or access panels are opened shall be identified by means of Seton Setmark or Brady Mechanical Pipe Markers. Concealed areas, for purposes of this identification section, are those areas which cannot be seen except by demolition of the building elements. In addition to the pipe markers, arrow markers shall be used to indicate direction of flow. The following specific instructions shall apply to the application of these markers:
- A. Provide a pipe marker at each valve to indicate proper identification of pipe contents. Where several valves exist on one header, it is necessary to mark only the header.
  - B. Provide an arrow marker with each pipe marker pointing away from the pipe marker to indicate direction of flow.

- C. Provide a double ended arrow marker when flow can be in either or both directions.
  - D. Provide a pipe marker and an arrow marker at every point of pipe entry or exit where line goes through a wall or service column.
  - E. Provide pipe markers and arrow markers at intervals not exceeding 50 feet.
  - F. Markers shall be located on the two lower quarters of the pipe where view is unobstructed.
  - G. Use Seton Setmark Type SNA or Brady snap-on type identification for all piping systems, 3/4" thru 6". For piping systems larger than 6", use Seton or Brady strap on markers.
  - H. Pipe Markers shall conform to ANSI A 13.1-1981 "Scheme for the Identification of Piping Systems." Arrow markers must have same ANSI background colors as their companion pipe markers, or be incorporated into the pipe identification marker.
  - I. Locate markers to be visible from floor.
- 2.12 Specials: Refer to special requirements noted in the various sections hereinafter bound.

**PART 3 EXECUTION**

**3.01 PREPARATION**

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 91 00 for stencil painting.

**3.02 INSTALLATION**

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Apply stencil painting in accordance with Section 09 91 00.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- F. Install underground plastic pipe markers 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe.
- G. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with [plastic nameplates.] [stencil painting.] Small devices, such as in-line pumps, may be identified with tags.
- H. Identify control panels and major control components outside panels with plastic nameplates.

- I. Identify thermostats relating to terminal boxes or valves with nameplates.
- J. Identify valves in main and branch piping with tags.
- K. Identify air terminal units and radiator valves with numbered tags.
- L. Tag automatic controls, instruments, and relays. Key to control schematic.
- M. Provide ceiling tacks to locate valves, dampers or other concealed equipment above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

**END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

## SECTION 23 05 93

### SYSTEM TESTING, ADJUSTING AND BALANCING

#### PART 1 GENERAL

##### 1.00 The following sections are to be included as if written herein:

- A. 23 00 00 -- Basic Mechanical Requirements
- B. 23 05 29 -- Sleeves, Flashings, Supports and Anchors
- C. 23 05 53 -- Mechanical Identification
- D. 23 36 00 -- Air Terminal Units (VAV)

##### 1.01 SUMMARY

- A. Testing, adjusting and balancing (TAB) of the air conditioning systems and related ancillary equipment will be performed by an impartial technically qualified TAB firm selected and employed by the Owner, separate and apart from the construction contract.
- B. The firm shall be capable of performing the services specified at the location of the facility described within the time specified, of preparing and submitting the detailed report of the actual field work performed, and following up the basic work as may be required.

##### 1.02 QUALIFICATIONS

- A. The Firm shall be one which is organized to provide professional services of this specified type in the State of Texas and as a minimum shall have one (1) professional engineer licensed in the State of Texas, with current registration, to perform such professional services. This engineer shall be personally responsible for developing the job site data as required in the test procedures outlined in these Specifications.
- B. The Firm shall have operated a minimum of five (5) years under its current Firm name, and shall be in good standing with the State of Texas, Franchise Tax Board. The firm shall submit their full incorporated name, Charter Number and Taxpayer's I.D. Number for proper verification of the firm's status.
- C. The Firm shall be capable of providing a performance bond, by a bonding company licensed to do business in the State of Texas, if determined by the Owner that such a bond is required. The amount of the bond which may be required shall be equal to the cost of the proposal submitted, or in the case of more than one proposal, the sum of all such proposals and any awarded work in progress.
- D. All personnel used on the job site shall be either professional engineers or engineering technicians, who shall have been permanent, full time employees of the firm for a minimum of six (6) months prior to the start of work for this specific project.
- E. The TAB firm shall submit biographical data on the individual proposed who will directly supervise the TAB work, as well as other personnel scheduled to perform the technical work under the contract. It shall also submit a background record of at least five years of specialized experience in the field of air hydronic system balancing, and shall possess properly calibrated instrumentation. The supervisory personnel for the TAB firm shall be

registered engineers in the mechanical field and all of the employees used in the TAB firm shall be permanent, full-time employees of the firm.

### **1.03 REFERENCES**

- A. AABC - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems, Sixth Edition, 2002.
- B. ASHRAE - 2007 HVAC Applications Chapter 34: Testing, Adjusting and Balancing.
- C. ANSI/ASHRAE Standard 111-2008 - Practices for Measurement, Testing, Adjusting and Balancing of Buildings, Heating, Ventilation, Air Conditioning and Refrigeration Systems.

### **1.04 DOCUMENTS**

- A. The TAB firm shall, as a requirement of the TAB contract, arrange with the Architect to compile one set of mechanical specifications, all pertinent change orders, and the following:
  - 1. One complete set of Drawings less the structural sheets.
  - 2. One set of mechanical floor plans of the conditioned spaces. These Drawings shall be ozalid type (blue or black on light background) reproductions to facilitate marking.
- B. Approved submittal data on equipment installed, and related changes as required to accomplish the test procedures outlined in Paragraphs 1.06 through 1.10 of this Specification will be available through the Construction Inspector.

### **1.05 RESPONSIBILITIES OF THE TAB FIRM**

- A. The TAB personnel shall check, adjust, and balance the components of the air conditioning system which will result in optimal noise, temperature, and airflow conditions in the conditioned spaces of the building while the equipment of the system is operating economically. This is intended to be accomplished after the system components are installed and operating as provided for in the contract documents. It is the responsibility of the Mechanical Contractor to place the equipment into service. Variable air volume systems shall be balanced in accordance with AABC 2002 Standard, Sixth Edition.
- B. Liaison and Early Inspection:
  - 1. The TAB firm personnel on the job shall act as liaison between the Owner, Architect and Contractor. The following reviews (observations) and tests shall be performed by the TAB Agency:
    - a. During the design stage, before the documents are finalized, review the mechanical drawings and specifications for balanceability and provide commentary.
    - b. During construction, review all HVAC submittals such as control diagrams, air handling devices, etc., that pertain to commissioning work and balanceability.
    - c. Allow for a fixed number of trips to the project site, over and above those required for testing and balancing for inspection of installation of the mechanical piping systems, sheet metal work, temperature controls and



other component parts of the heating, air conditioning and ventilating systems during the construction stage. These inspections shall be made prior to and/or at the above ceiling inspection. Commentary will be provided to the RCM of each observation.

- d. Test one (1) 8" single duct terminal box for performance capability and leakage as described in Section 23 36 00. The shipment of the box to the TAB Agency's lab will be at the manufacturer's cost and the test period will be for three (3) weeks from receipt of the box. Submittal data will not be approved until box testing passes. If the sample box is rejected for any reason the second test will be at the Contractor's cost and the time allowed will restart when the box is received at the TAB Agency.
- e. Test one (1) 8" dual duct box for performance capability and leakage as described in Section 23 36 00. The shipment of the box to the TAB Agency's lab will be at the manufacturer's cost and the test period will be for three (3) weeks from receipt of the box. Submittal data will not be approved until box testing passes. If the sample box is rejected for any reason the second test will be at the Contractor's cost and the time allowed will restart when the box is received by the TAB agency.
- f. Test 10% of the single and dual duct boxes for casing and damper leakage when the shipment arrives at the project site. All testing (except for the initial boxes) shall be performed on site.

Boxes requiring re-testing will be charged to the Contractor at the unit price provided to the Owner.

- g. Test one (1) lab configuration including fume hood with air valve, general exhaust air with air valve and supply air with air valve for performance capability through a full range of inlet pressures. The tracking capability of the exhaust air versus the supply air will be with the submitted hood sash fully open and as the sash is closed in 2" increments until fully closed. Track the three (3) valves' response time in relation to sash movement and the lab differential.

- 2. During the balancing process, as abnormalities and malfunctions of equipment or components are discovered by the TAB personnel, the Construction Inspector shall be advised in writing so that the condition can be corrected by the Mechanical Contractor. The written document need not be formal, but must be understandable and legible. Data from malfunctioning equipment shall not be recorded in the final TAB report. The TAB firm shall not instruct or direct the Contractor in any of the work, but will make such reports as are necessary to the Owner.

## 1.06 FINAL AIR BALANCE

General: When systems are complete and ready for operation, the TAB Consultant will perform a final air balance for all air systems and record the results. The outside, supply, exhaust and return air volume for each air handling unit, supply fan and exhaust fan and the supply, exhaust or return air volume for each distribution device shall be adjusted to within  $\pm 5\%$  of the value shown on the drawings. Air handling unit and fan volumes shall be adjusted by changing fan speed and adjusting volume dampers associated with the unit. Air distribution device volume shall be adjusted using the spin-in tap damper for flexible duct connected devices and the device OBD for duct connected devices. Air distribution devices shall be balanced with air patterns as specified. Duct volume dampers shall be adjusted to provide air volume to branch ducts where such dampers are shown. The general scope of balancing by the TAB Consultant will include, but is not limited to, the following:

1. Filters: Check air filters and filter media and balance only system with essentially clean filters and filter media. The Division 23 Contractor shall install new filters and filter media prior to the final air balance.
2. Blower Speed: Measure RPM at each fan or blower to design requirements. Where a speed adjustment is required, the Division 23 Contractor shall make any required changes.
3. Ampere Readings: Measure and record full load amperes for motors.
4. Static Pressure: Static pressure gains or losses shall be measured across each supply fan, cooling coil, heating coil, return air fan, air handling unit filter and exhaust fan. These readings shall be measured and recorded for this report at the furthest air device or terminal unit from the air handler supplying that device. Static pressure readings shall also be provided for systems which do not perform as designed.
5. Equipment Air Flow: Adjust and record exhaust, return, outside and supply air CFM (s) and temperatures, as applicable, at each fan, blower and coil.
6. Coil Temperatures: Set controls for full cooling and for full heating loads. Read and record entering and leaving dry bulb and wet bulb temperatures (cooling only) at each cooling coil, heating coil and HVAC terminal unit. At the time of reading record water flow and entering and leaving water temperatures (In variable flow systems adjust the water flow to design for all the above readings).
7. Zone Air Flow: Adjust each zone of multizone units, each HVAC terminal unit and air handling unit for design CFM.
8. Outlet Air Flow: Adjust each exhaust inlet and supply diffuser, register and grille to within  $\pm 5\%$  of design air CFM. Include all terminal points of air supply and all points of exhaust. Note: For Labs and Rooms that are negative exhaust air flow shall be set to design  $+10\%$  and supply to design  $-5\%$ . Positive areas will have opposite tolerances.
9. Pitot Tube Traverses: For use in future troubleshooting by maintenance personnel, all exhaust ducts, main supply ducts and return ducts shall have air velocity and volume measured and recorded by the traverse method. Locations of these traverse test stations shall be described on the sheet containing the data.
10. Maximum and minimum air flow on terminal boxes.

## **1.07 SOUND VIBRATION AND ALIGNMENT**

- A. Sound: Read and record sound levels at up to 15 locations in the building designated by the Engineer. All measurements shall be made using an Octave Band Analyzer. All tests shall be conducted when the building is quiet in the presence of the Engineer, if he so desires.
- B. Vibration: Read and record vibration for all water circulating pumps, air handling units, and fans which have motors larger than 10 HP. Include equipment vibration, bearing housing vibration, foundation vibration, building structure vibration, and other tests as directed by the Engineer. Readings will be made using portable IRD (or approved equal) equipment capable of filtering out various unwanted frequencies and standard reporting forms. Maximum vibration at any point listed above, or specified, shall not exceed 1 mil on fans and 1 mil on pumps unless otherwise specified. Equipment manufacturers shall rectify all systems exceeding vibration tolerances.

## **1.08 TESTING OF TEMPERATURE CONTROL SYSTEMS**

- A. In the process of performing the TAB work, the TAB Agency shall:
  - 1. Work with the temperature control contractor to ensure the most effective total system operation within the design limitations, and to obtain mutual understanding of intended control performance.
  - 2. Verify that all control devices are properly connected.
  - 3. Verify that all dampers, valves and other controlled devices are operated by the intended controller.
  - 4. Verify that all dampers and valves are in the position indicated by the controller (open, closed or modulating).
  - 5. Verify the integrity of valves and dampers in terms of tightness of close-off and full-open positions. This includes dampers in multizone units, terminal boxes and fire/smoke dampers.
  - 6. Observe that all valves are properly installed in the piping system in relation to direction of flow and location.
  - 7. Observe the calibration of all controllers.
  - 8. Verify the proper application of all normally opened and normally closed valves.
  - 9. Observe the locations of all thermostats and humidistats for potential erratic operation from outside influences such as sunlight, drafts or cold walls.
  - 10. Observe the locations of all sensors to determine whether their position will allow them to sense only the intended temperatures or pressures of the media. Control Contractor will relocate as deemed necessary by the TAB Agency.
  - 11. Verify that the sequence of operation for any control mode is in accordance with approved shop drawings and specifications. Verify that no simultaneous heating and cooling occurs.

12. Verify that all controller setpoints meet the design intent.
  13. Check all dampers for free travel.
  14. Verify the operation of all interlock systems.
  15. Perform variable volume system verification to assure the system and its components track with changes from full flow to minimum flow.
- B. A systematic listing of the above testing and verification shall be included in the final TAB report.

## 1.09 REPORTS

- A. The activities described in this section shall culminate in a report to be provided in quadruplicate (4) individually bound to the RCM. Neatly type and arrange data. Include with the data the date tested, personnel present, weather conditions, nameplate record of test instrument and list all measurements taken after all corrections are made to the system. Record all failures and corrective action taken to remedy incorrect situation. The intent of the final report is to provide a reference of actual operating conditions for the Owner's operations personnel.
- B. All measurements and recorded readings (of air, water, electricity, etc.) that appear in the reports must have been made onsite by the permanently employed technicians or engineers of the firm.
- C. At the option of the Construction Inspector, all data sheets tabulated each day by TAB personnel shall be submitted for initial by the Construction Inspector. Those work sheets so initialed, or copies thereof, shall be presented as a supplement to the final TAB report.
- D. Submit reports on forms approved by the Owner & Engineer which will include the following information as a minimum:
1. Title Page
    - a) Company Name
    - b) Company Address
    - c) Company telephone number
    - d) Project name
    - e) Project location
    - f) Project Manager
    - g) Project Engineer
    - h) Project Contractor
    - i) Project Identification Number
  2. Instrument List
    - a) Instrument
    - b) Manufacturer
    - c) Model
    - d) Serial Number
    - e) Range
    - f) Calibration date

- g) What test instrument was used for
3. Fan Data (Supply and Exhaust)
    - a) Location
    - b) Manufacturer
    - c) Model
    - d) Air flow, specified and actual
    - e) Total static pressure (total external), specified and actual
    - f) Inlet pressure
    - g) Discharge pressure
    - h) Fan RPM
  4. Return Air/Outside Air Data (If fans are used, same data as for 3 above)
    - a) Identification/location
    - b) Design return air flow
    - c) Actual return air flow
    - d) Design outside air flow
    - f) Return air temperature
    - g) Outside air temperature
    - h) Required mixed air temperature
    - i) Actual mixed air temperature
  5. Electric Motors
    - a) Manufacturer
    - b) HP/BHP
    - c) Phase, voltage, amperage, nameplate, actual
    - d) RPM
    - e) Service factor
    - f) Starter size, heater elements, rating
  6. V-Belt Drive
    - a) Identification/location
    - b) Required driven RPM
    - c) Driven sheave, diameter and RPM
    - d) Belt, size and quantity
    - e) Motor sheave, diameter and RPM
    - f) Center-to-center distance, maximum, minimum and actual
  7. Duct Traverse
    - a) System zone/branch
    - b) Duct size
    - c) Area
    - d) Design velocity
    - e) Design air flow
    - f) Test velocity
    - g) Test air flow
    - h) Duct static pressure
    - i) Air temperature
    - j) Air correction factor

8. Air Distribution Test Sheet
  - a) Air terminal number
  - b) Room number/location
  - c) Terminal type
  - d) Terminal size
  - e) Area factor
  - f) Design velocity
  - g) Design air flow
  - h) Test (final) velocity
  - i) Test (final) air flow
  
9. Pump Data
  - a) Identification/number
  - b) Manufacturer
  - c) Size/model
  - d) Impeller
  - e) Service
  - f) Design flow rate, pressure drop, BHP
  - g) Actual flow rate, pressure drop, BHP
  - h) Discharge pressure
  - i) Suction pressure
  - j) Total operating head pressure
  - k) Shut off, discharge and suction pressure
  - l) Shut off, total head pressure
  - m) Pressure differential settings
  
10. Control verification indicating date performed and any abnormalities identified.
  - a) Point Location/Description
  - b) EMS Readout (Setpoint and Actual)
  - c) Actual Readout
  - d) Interlocks
  - e) Safeties
    - 1) VSD Normal Operation
    - 2) VSD Bypass Operation
  - f) Alarms
  - g) Sequences of Operation

**END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

## SECTION 23 05 93.A

### SYSTEM PREPARATION FOR TESTING, ADJUSTING AND BALANCING

#### PART 1 GENERAL

##### 1.00 The following sections are to be included as if written herein:

- A. Section 23 00 00 – Basic Mechanical Requirements
- B. Section 23 05 29 – Sleeves, Flashings, Supports and Anchors
- C. Section 23 05 53 – Mechanical Identification

##### 1.01 SUMMARY

- A. Perform all work required to prepare the building HVAC systems for testing, adjusting and balancing indicated by the Contract Documents as follows:
  - 1. Responsibilities of project contractor
  - 2. Preparation for balancing of air systems
  - 3. Preparation for balancing of hydronic and steam systems
- B. The scope of the TAB work as defined in Section 23 05 93 is indicated in order that the Contractor will be advised of the coordination, adjustment, and system modification which will be required under the project work in order to complete the Owner's requirements for final TAB. The TAB firm will not have a contractual relationship with any Contractor referred to herein, but will be responsible to the Construction Inspector and the Owner for the satisfactory execution of the TAB work. The Contractor in his original bid shall allow for the costs required to cover all work which may be required in the TAB phases as defined herein and as may be necessary for the completion of the TAB work as defined by the TAB firm.

##### 1.02 RELATED SECTIONS

- A. Section 23 05 48 - Vibration Isolation
- B. Section 23 05 93 – System Testing, Adjusting and Balancing
- C. Section 23 06 20.13 - Hydronic Specialties
- D. Section 23 09 23 - Direct Digital Control Systems
- E. Section 23 20 00 - HVAC Pumps
- F. Section 23 31 00 - Ductwork
- G. Section 23 33 00 - Ductwork Accessories
- H. Section 23 34 16 - Fans
- I. Section 23 36 00 - Air Terminal Units (VAV)

### 1.03 SCOPE OF WORK

- A. Testing, adjusting, and balancing (TAB) of the air conditioning systems and related ancillary equipment will be performed by an impartial technically qualified TAB firm selected and employed directly by the Owner, separate and apart from the Construction Contract. However, the preparation for and corrections necessary for the Testing, Adjusting and Balancing of these systems, as described herein, are the responsibility of the Contractor.
- B. As a part of this project Construction Contract, the Contractor shall make any changes or replacements to the sheaves, belts, dampers, valves, etc. required for correct balance as advised by the TAB firm, at no additional cost to the Owner.
- C. The Contractor shall provide and coordinate the services of qualified, responsible Subcontractors, suppliers and personnel as required to correct, repair, and/or replace any and all deficient items or conditions found during the course of this project, including the testing, adjusting and balancing period.
- D. In order that all systems may be properly tested, balanced, and adjusted as required herein by these Specifications, the Contractor shall operate said systems at his expense for the length of time necessary to properly verify their completion and readiness for TAB. This length of time shall be subject to the approval of the Construction Inspector.
- E. Project Contract completion schedules shall allow for sufficient time to permit the completion of TAB services prior to Owner occupancy. The contractor shall allow adequate time for the testing and balancing activities of the owner provided services, during the construction period, and prior to Substantial Completion as defined in the Uniform General Conditions of this Construction Document.
- F. The Drawings and Specifications indicate valves, dampers and miscellaneous adjustment devices for the purpose of adjustment to obtain optimum operating conditions, and it will be the responsibility of the Contractor to install these devices in a manner that will leave them accessible and readily adjustable. Should any such device not be readily accessible, the Contractor shall provide access as requested by the TAB firm. Also, any malfunction encountered by TAB personnel and reported to the Contractor or the Construction Inspector shall be corrected by the Contractor immediately so that the balancing work can proceed with the minimum of delays.

### 1.04 RESPONSIBILITIES OF THE PROJECT CONTRACTOR:

- A. The Contractor shall:
  - 1. Have the building and air conditioning systems in complete operational readiness for TAB work to begin.
  - 2. The contractor shall allow sufficient time for the TAB firm to perform his contracted work within the construction schedule. The contractor shall complete his work by systems or floors whichever is the most efficient for scheduling. After awarding of the contract and the contractor has developed a construction schedule, a TAB coordination meeting shall be held at the RCM's office with the TAB agency, the general contractor and his primary subcontractors (i.e. mechanical, electrical, building automation etc.) to develop a testing schedule for the project. The contractor shall submit copies of the proposed schedule two (2) weeks prior to this meeting to the RCM and TAB Agency.



Note: The hot water and chilled water systems must be 100% complete to balance. The air systems are pressure independent and can be balanced by floors, risers, systems, etc., but once the total system is complete the total flows and system tracking will require finalization. Lab certification will be performed when the building is 100% operational and balanced.

3. Promptly correct deficiencies of materials and workmanship identified as delaying completion of TAB work.
  4. Be responsible for any added costs to the Owner resulting from his failure to have the building and air conditioning systems ready for TAB when scheduled, or from his failure to correct deficiencies promptly.
- B. Complete operational readiness of the building requires that construction status of the building shall permit the closing of doors, windows, ceilings installed, etc., to obtain simulated or projected operating conditions.
- C. Complete operational readiness of the air conditioning systems also requires that the following be accomplished:
1. Air Distribution Systems:
    - a. Verify installation for conformity to design. All supply, return and exhaust ducts terminated and pressure tested for leakage as required by the Specification.
    - b. All volume, smoke and fire/smoke dampers are properly located and functional. Dampers serving requirements of minimum and maximum outside, return and relief air shall provide tight closure and full opening, smooth and free operation.
    - c. All supply, return, exhaust and transfer grilles, registers, diffusers and terminal devices installed.
    - d. Air handling systems, units and associated apparatus, such as heating and cooling coils, filter sections, access doors, etc., shall be blanked and/or sealed to eliminate excessive bypass or leakage of air.
    - e. All fans (supply, return and exhaust) operating and verified for freedom from vibration, proper fan rotation and belt tension; heater elements in motor starters to be of proper size and rating; record motor amperage and voltage on each phase at start-up and running, and verify they do not exceed nameplate ratings.
    - f. All single and/or double duct variable and constant volume terminal units ("mixing boxes") shall be installed and functional (i.e. controls functioning).
  2. Water Circulating Systems:
    - a. Check and verify pump alignment and rotation.
    - b. Open all valves to their full open position, close bypass stop valves. Set mixing valves to full-flow through systems components. After the system is

flushed and checked for proper operation, remove and clean all strainers. The Contractor shall repeat the operation until circulating water is clean.

- c. Record each pump motor amperage on each phase and voltage after reaching rated speed. Readings shall not exceed nameplate rating.
- d. Verify that the electrical heater elements are of the proper size and rating.
- e. In preparation of TAB all water circulating systems shall be full and free of air, expansion tanks shall be set for proper water level, and all air vents shall be installed at high points of systems and operating freely. Systems shall be cleaned and flushed. Chemicals shall be added to closed systems to treat piping and inhibit corrosion.
- f. Check and set operating parameters of the heat exchangers and control devices to the design requirements.

3. Automatic Controls:

- a. The Contractor shall schedule a meeting with the Engineer, Control Contractor, TAB firm and Owner's representative for a pre-submittal review to establish that their interpretations of the sequences of operation are correct.
- b. Verify that all control components are installed in accordance with project requirements and are functional, including all electrical interlocks, dampers sequences, air and water resets, fire and freeze stats, high and low temperature thermostats, safeties, etc.
- c. Verify that all controlling instruments are calibrated and set for design operating conditions with the exception of room thermostats or sensors, which shall be calibrated at the completion of TAB services with cooperation between the TAB firm and Control Contractor.
- d. The Automatic Temperature Control Contractor and/or Energy Management System Contractor shall thoroughly check all controls, sensors, operators, sequences, etc. before notifying the TAB agency that the Automatic Temperature Controls and Energy Management System are operational. The Automatic Temperature Contractor and/or Energy Management System Contractor shall provide technical support (technicians and necessary computers) to the TAB agency for a complete check of these systems.

4. Tabulated Data: The motor amperages, voltages shall be recorded showing "actual" and "nameplate" voltage and amperage and submitted and actual RPM. This applies to each piece of electrically driven air conditioning equipment in the system including supply and exhaust fans, fans of fractional horsepower, pumps, etc.

D. Notification of System Readiness:

- 1. After completion of the work in Paragraph 1.05 A through C above, the Contractor shall notify the Owner in writing, certifying that the work has been accomplished and that the building and the air conditioning systems are in operational readiness for

testing, adjusting, and balancing. He shall include a copy of the tabulated data of Paragraph 1.05C.4 above.

2. The Owner will, in turn, notify the TAB firm of the readiness for balancing and forward copies of the Contractor's certification and the tabulated voltages and currents.
3. Should the TAB firm be notified as described above, and the TAB work commenced and the systems are found NOT to be in readiness or a dispute occurs as to the readiness of the systems, the Contractor shall request an inspection be made by duly appointed representative of the Owner, Architect, TAB firm and the Contractor. This inspection will establish to the satisfaction of the represented parties whether or not the systems meet the basic requirements for TAB services. Should the inspection reveal the TAB services notification to have been premature, all cost of the inspection and wasted work accomplished by the TAB firm shall be reimbursed to the appropriated parties by the Project Contractor.

#### **1.05 RESPONSIBILITIES OF THE TAB FIRM**

- A. Refer to Section 23 05 93 entitled "System Testing, Adjusting and Balancing."

#### **END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

This Page is Intentionally Blank

**SECTION 23 06 20.13**  
**HYDRONIC SPECIALTIES**

**PART 1 GENERAL**

**1.00 The following sections are to be included as if written herein:**

- A. Section 23 00 00 – Basic Mechanical Requirements
- B. Section 23 05 29 – Sleeves, Flashings, Supports and Anchors
- C. Section 23 05 53 – Mechanical Identification

**1.01 WORK INCLUDED**

- A. Automatic Air Vents
- B. Air Separators
- C. Strainers
- D. Gauges and Gauge Connections
- E. Thermometer and Thermometer Wells
- F. Pump Suction Fittings
- G. Water Relief Valves

**1.02 RELATED WORK**

- A. Section 22 13 16 - Plumbing Piping
- B. Section 23 21 00 - Hydronic Piping

**1.03 REFERENCES**

- A. ANSI/ASME - Boilers and Pressure Vessels Code

**1.04 REGULATORY REQUIREMENTS**

- A. Conform to ANSI/ASME Boilers and Pressure Vessels Code Section 8D for manufacture of tanks.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer: For each product specified, provide components by same manufacturer throughout.

**1.06 SUBMITTALS**

- A. Submit shop drawings and product data under provisions of Section 23 00 00.

- B. Submit shop drawings and product data for manufactured products and assemblies required for this project.
- C. Include component sizes, rough in requirements, service sizes, and finishes. Include product description, model number and dimensions.
- E. Submit manufacturer's installation instructions under provisions of Section 23 00 00.

**1.07 OPERATION AND MAINTENANCE DATA**

- A. Submit operation and maintenance data under provisions of Section 23 00 00.
- B. Include installation instruction, assembly views, lubrication instructions, and replacement parts list.

**1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to site under provisions of Section 23 00 00.
- B. Store and protect products under provisions of Section 23 00 00.

**PART 2 PRODUCTS**

**2.01 AUTOMATIC AIR VENTS**

- A. Provide at the highest points of the chilled water system and on the chilled water coils as shown on the Drawings, an automatic air vent, Armstrong No. 21AR or approved equal, with a pressure rating of 250 psig. Provide shut-off valve to facilitate maintenance of air vent. Locate all air vents and their discharge lines in accessible locations, preferably clustered.

**2.02 AIR SEPARATORS**

- A. Dip Tube Fitting: For 125 psig operating pressure; to prevent free air collected in boiler from rising into system.
- B. In-line Air Separators: Cast iron for sizes 1-1/2 inches and smaller, or steel for sizes 2 inches and larger; tested and stamped in accordance with Section 8D of ANSI/ASME Code; for 125 psig operating pressure.
- C. Air Elimination Valve: Bronze, float operated, for 125 psig operating pressure.
- D. Combination Air Separators/Strainers: Steel, tested and stamped in accordance with Section 8D of ANSI/ASME Code, for 125 psig operating pressure, with galvanized steel integral strainer with 3/16 inch perforations, tangential inlet and outlet connections, and internal stainless steel air collector tube.

**2.03 STRAINERS**

- A. Each control valve for chilled water and heating water, and each pressure reducing valve assembly regardless of its size shall be preceded by a sediment strainer. The arrangement of these sediment strainers shall be such that the screens may be removed for cleaning with ease through a gasketed plug. Monel or stainless steel shall be used to fabricate the noncollapsible lapped screens, which shall contain no soldered joints.

- B. Sediment strainers shall be placed in piping systems wherever shown on the Drawings and at such other points as may be required for the removal of foreign material from the piping systems.
- C. Strainers for water piping 2-1/2" and larger shall be Crane No. 989-1/2 Sediment Separators or approved equal. In piping two inches (2") and smaller, they shall be Crane No. 988-1/2, or approved equal.
- D. Strainers, 2" and smaller, bronze body, screwed ends, No. 10 mesh strainer, screwed cap with bronze blow off valve (size to be determined by standard tap size in cap). Cast iron body, 2 1/2" and larger, isolating type flanged ends where installed in copper lines, No. 7 perforated monel strainer, flanged cap with bronze ball blow off valve (size of blow off valve shall be determined by standard tap size in cap). Special Note: All strainers 6" and larger shall have studs mounted in the body flange in lieu of bolts for removal of cap. Baskets for strainers 6" and larger shall have stainless steel reinforcing bands at ends to prevent collapsing.
- E. Full sized blow off valves shall be installed on all strainers in steam, condensate, chilled and hot water lines and a drain shall be installed from each valve to the nearest floor drain.

#### **2.04 GAUGES AND GAUGE CONNECTIONS**

- A. Furnish and install Ashcroft No. 1279A Duragauges on both suction and discharge sides of pumps, complete with Ashcroft No. 1095 lever handle shut-off cocks, and Ashcroft No. 1106B pulsation piston type dampeners, or approved equal. Porous type will not be accepted. See pump Specifications. Gauges shall have stainless steel movement and 1/2 of 1% accuracy. Gauges shall have back connection when used on a panel; otherwise they shall have bottom connections. The graduation of the dials and the arrangement of the mechanisms shall conform to the pressure range details shown on the Drawings.
- B. Combination pressure or vacuum gauges shall be Ashcroft Duragauges Number 1279AC, or approved equal. The accessories for these gauges shall conform to those prescribed for pressure gauges.
- C. Furnish and install, where noted or indicated on the accompanying Drawings or called for elsewhere in these Specifications, gauge connections complete with Ashcroft No. 1095 lever handle union shutoff cocks, or approved equal. All gauge connections shall be made up with brass pipe, nipples and brass screw fittings.

#### **2.05 THERMOMETER AND THERMOMETER WELLS**

- A. Furnish and install thermometers of not less than 9" scale complete with brass separable sockets with extension neck to allow for insulation of piping. These thermometers shall be mercury red reading type in one piece glass tubes extending from top of scale to sensor, and shall be located so that they may be easily read. Field adjustable angle thermometers are acceptable. Thermometers shall in all cases be installed upright or at the proper angle to be read while standing on the floor. The wells for thermometers shall be located in vertical pipes where possible and when necessary in horizontal pipes they shall be installed in the side and not on the top of the pipe. They shall be Weksler Industrial Thermometers, or approved equal, with range of 0 to 100 degrees F. for chilled water, and 0 to 220 degrees F for hot water.
- B. Thermometer wells and thermometers shall be located where noted on the accompanying Drawings and where called for in other sections of the Specifications. Thermometer test

wells only shall be installed in a vertical position in horizontal lines and at 45 degrees, in vertical lines to hold a fluid in the well.

- C. Thermometer test wells shall be 3/4" Weksler Thermal Wells, brass with stem of minimum length to extend beyond the mid-diameter of the pipe, 2-1/2" extension neck, and brass screw plug. Wells shall be suitable for use of industrial type thermometers.
- D. Indicating thermometers shall be placed in lines wherever shown on the Drawings. These thermometers shall be Weksler Industrial Thermometers having stainless steel separable sockets and scales of the range shown on the Drawings.
- E. Provide thermometer and thermowell assemblies, as described above, with one assembly each for the chilled water supply and return main pipes. Install the assemblies in close proximity to the RTDs that are provided for the chilled water BTU meter.

## **2.06 PUMP SUCTION FITTINGS**

- A. Fitting: Angle pattern, cast iron body, threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger, rated for 175 psig working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable fine mesh strainer to fit over cylinder strainer, and permanent magnet located in flow stream and removable for cleaning.
- B. Suction diffusers shall be Paco or approved equal, cast iron body and cover, steel diffuser, and stainless steel strainer, 125 pound ASA (flat face) flange for a working pressure of 175 psi and temperature of 300°F.
- C. Accessories: Adjustable foot support, blow down tapping in bottom, gauge tapping in side.

## **2.07 WATER RELIEF VALVES**

- A. The pressure relief valves installed for the protection of the water circulating circuits shall be McAlear No. 307 single seated diaphragm and spring type valves with screwed connections or approved equal. They shall be 3/4" size of bronze construction with bronze seat, composition shut-off disc and rubber diaphragm.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION AND APPLICATION**

- A. Install specialties in accordance with manufacturer's instructions to permit intended performance.
- B. Support tanks inside building from building structure in accordance with manufacturer's instructions.
- C. Provide manual air vents at system high points and as indicated.
- D. Provide manual air vents at entrance to all heating hot water coils, with a "cane" shaped discharge tube, positioned to permit draining to a portable receptacle.
- E. For automatic air vents in ceiling spaces or other concealed locations, extend vent tubing to nearest drain.



- F. Provide air separator on suction side of system circulation pump and connect to expansion tank.
- G. Provide valved drain and hose connection on strainer blow down connection.
- H. Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove temporary strainers after cleaning systems. Clean all permanent strainers after circulating systems for a minimum of 48 hours at full capacity.
- I. Support pump fittings with floor mounted pipe and flange supports.
- J. Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.
- K. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.
- L. Pipe relief valve outlet to nearest floor drain.
- M. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

**END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

This Page is Intentionally Blank

## SECTION 23 07 13

### DUCTWORK INSULATION

#### PART 1 GENERAL

##### **1.00 The following sections are to be included as if written herein:**

- A. Section 23 00 00 – Basic Mechanical Requirements
- B. Section 23 05 29 – Sleeves, Flashings, Supports and Anchors
- C. Section 23 05 53 – Mechanical Identification

##### **1.01 SECTION INCLUDES**

- A. Ductwork insulation
- B. Insulation jackets

##### **1.02 RELATED SECTIONS**

- A. Section 09 91 00 - Painting: Painting insulation jackets
- B. Section 23 31 00 - Ductwork: Duct liner
- C. Section 23 33 00 - Ductwork Accessories: Duct liner

##### **1.03 REFERENCES**

- A. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate
- B. ASTM C518 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
- C. ASTM C553 - Mineral Fiber Blanket and Felt Insulation
- D. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation
- E. ASTM E84 - Surface Burning Characteristics of Building Materials
- F. ASTM E96 - Water Vapor Transmission of Materials
- G. NFPA 255 - Surface Burning Characteristics of Building Materials
- H. SMACNA - HVAC Duct Construction Standards - Metal and Flexible
- I. UL 723 - Surface Burning Characteristics of Building Materials

##### **1.04 SUBMITTALS**

- A. Submit under provisions of Section 23 00 00.
- B. Product Data: Provide product description, list of materials and thickness for each service, and locations.

- C. Samples: Submit two samples of any representative size illustrating each insulation type.
- D. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.

**1.05 QUALITY ASSURANCE**

- A. Materials: Flame spread/smoke developed rating of 25/50 in accordance with NFPA 255.

**1.06 QUALIFICATIONS**

- A. Applicator: Company specializing in performing the work of this section with minimum three years experience.

**1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, protect and handle products to site under provisions of Section 23 00 00.
- B. Deliver materials to site in original factory packaging, labeled with manufacturer's density and thickness.
- C. Store insulation in original wrapping and protect from weather and construction traffic.
- D. Protect insulation against dirt, water, chemical, and mechanical damage.

**1.08 ENVIRONMENTAL REQUIREMENTS**

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

**PART 2 PRODUCTS**

**2.01 Insulation A:**

- A. Three pound per cubic foot minimum density glass fiber semi-rigid board insulation with fiber perpendicular to the surface and with factory applied white foil reinforced vapor barrier jacket (ASJ). Insulation shall be equal to E.O. Woods Company "Rigid-Wrap".
- B. The insulation shall be secured to the ducts with mechanical fasteners; "Stick-clips", Graham Pins or Speed Clips, and shall be spaced approximately 12" on center on bottom of duct and where required elsewhere to hold insulation securely against the duct as noted in the published recommendations of the Insulation Manufacturer.
- C. After insulation is in place, all joints and seams shall be sealed with Foster 30-35 white vapor barrier emulsion applied over a 3" wide strip of Duramesh Glass Fabric. All protrusions through the vapor barrier shall be thoroughly sealed.
- D. On ducts that are reinforced with standing seams or angle iron stiffeners 1" and over in height, the Contractor shall apply a strip of fiberglass board 1" thick by 6" wide, sealing same to the other insulation with mastic.
- E. Vapor sealing of joints and seams is not required on hot duct application where concealed.

**2.02      Insulation B:**

- A. Three pound per cubic foot minimum density glass fiber rigid board insulation with factory applied white foil reinforced All Service Jacket (ASJ).
- B. Insulation B shall be applied as specified for Insulation A.
- C. Contractor at his option may substitute Insulation A where Insulation B is called for.

**2.03      Insulation C:**

- A. Blanket insulation with a thermal conductivity (K) of 0.27 or less similar in construction to Owens-Corning Fiberglass Series one pound per cubic foot minimum density with foil reinforced Kraft (FRK) vapor barrier facing. Insulation shall be wrapped tightly on the ductwork with all circumferential joints butted and longitudinal joints overlapped a minimum of 2". Adhere insulation to metal with 4" strips of insulation bonding adhesive at 8" on center. On circumferential and longitudinal joints, the 2" flange of the facing shall be secured using 9/16" flare door staples applied 6" on center and taped with 4" wide fiberglass tape embedded in Foster 30-35 white vapor barrier Emulsion and covered with Foster 30-35 white vapor barrier Emulsion until the tape is completely covered. All pin penetrations or punctures in facing shall also be taped. Vapor sealing of joints is not required on hot duct application where concealed.

2.04 All ductwork in the building and in the crawl spaces except toilet exhaust and fume hood exhaust ducts shall be insulated externally unless specifically excluded. Only sound attenuated return ducting may be insulated internally, if specifically designated as such.

2.05 Where ducts are lined internally, (see Drawings for Scope) no exterior insulation will be required, except where specifically stated otherwise. Where internal and external insulation join, they shall lap at least 24 inches.

2.06 Low pressure supply duct taps to ceiling diffusers shall be externally insulated including top of ceiling diffuser with 2" Insulation C.

2.07 Flexible round ducts are specified in Section 23 31 00.UT as factory insulated.

2.08 All kitchen hood exhaust ductwork connected to both inlet and discharge sides of Fans shall be insulated. Insulation shall be 1" insulation A or B.

**PART 3      EXECUTION**

**3.01      EXAMINATION**

- A. Verify that ductwork has been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

**3.02      INSTALLATION**

- A. Install materials in accordance with manufacturer's instructions.
- B. Insulated ductwork conveying air below ambient temperature:
  - 1. Provide insulation with vapor barrier jackets.
  - 2. Finish with tape and vapor barrier 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. Insulated ductwork conveying air above ambient temperature:
1. Provide with or without standard vapor barrier jacket.
  2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- D. For ductwork exposed in mechanical equipment rooms or in finished spaces, finish with aluminum jacket.
- E. For exterior applications, provide insulation with vapor barrier jacket. Cover with caulked aluminum jacket with seams located on bottom side of horizontal duct section.
- F. External Duct Insulation Application:
1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive to match jacket.
  2. Secure insulation without vapor barrier 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 barrier penetrations by mechanical fasteners with vapor barrier adhesive.
  5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- G. Duct and Plenum Liner Application:
1. Adhere insulation with adhesive for 100 percent coverage.
  2. Secure insulation with mechanical liner fasteners. Refer to SMACNA Standards for spacing.
  3. Seal and smooth joints.
  4. Seal liner surface penetrations with adhesive.
  5. Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.
- 3.03 All piping, equipment, ductwork, all plenums including metal and masonry construction, fans, etc., shall be insulated as indicated on the Drawings, as specified herein, and as required for a complete system. In each case, the insulation shall be equal to that specified and materials applied and finished as described in these Specifications.
- 3.04 All insulation shall be applied by mechanics skilled in this particular work and regularly engaged in such occupation. All insulation shall be applied in strict accordance with these Specifications

and with factory printed recommendations on items not herein mentioned. Unsightly, inadequate, or sloppy work will not be acceptable, and all such work shall be removed and replaced as many times as necessary to achieve an acceptable installation.

- 3.05 All insulation, jacket, adhesives, mastics, sealers, etc., utilized in the fabrication of these systems shall meet NFPA for fire resistant ratings (maximum of 25 flame spread and 50 smoke developed ratings) and shall be approved by the insulation manufacturer for guaranteed performances when incorporated into their insulation system, unless a specific product is specified for a specific application, and is stated as an exception to this requirement. Certificates to this effect shall be submitted along with Contractor's submittal data for this section of the Specifications. No material may be used that, when tested by the ASTM E84-89 test method, is found to melt, drip or delaminate to such a degree that the continuity of the flame front is destroyed, thereby resulting in an artificially low flame spread rating.
- 3.06 All surfaces to be insulated shall be clean and dry before applying the insulation. All sections of molded pipe covering shall be firmly butted together. Where an insulation covering is applied, it shall lap the adjoining section of insulation by at least three inches (3"). Where insulation terminates, it shall be neatly beveled and finished. No insulation shall be applied until the pipe, duct, etc., have been pressure tested and found tight. Piping, flexible connections, flanges, valves, strainers, and unions shall be covered unless specifically noted otherwise. Flexible connections on duct shall not be covered. All materials used shall be fire retardant or nonflammable. Refer to Section 15A.
- 3.07 Where vapor barriers are required, the vapor barrier shall be on the outside. Extreme care shall be taken that the vapor barrier is unbroken. Joints, etc., shall all be sealed. Where insulation with a vapor barrier terminates, it shall be sealed off with the vapor barrier being continuous to the surface being insulated. Ends shall not be left raw.
- 3.08 Extreme care shall be taken in covering high and medium pressure (high and medium pressure ductwork shall be all ductwork between the fan discharge and all mixing boxes) ductwork to insure the duct is not pierced with sheet metal screws or other fasteners. All high and medium pressure ducts in these specifications are classified as high velocity ductwork.
- 3.09 Where specified, aluminum bands shall be used on piping insulation. The bands shall be applied three (3) to a section of pipe. Fittings, valves, etc., shall have bands on each side.
- 3.10 Where canvas finish is specified, use Arabol lagging adhesive to prevent mildew in securing canvas. Do not use wheat paste. In addition, cover all canvas insulation with a fire retardant coating.
- 3.11 For purpose of definition in this Specification: "concealed" areas are those areas which cannot be seen by the building occupants, and "exposed" areas are all areas which are exposed to view by the building occupants, including under counter and inside cabinet areas, plus all mechanical rooms.
- 3.12 The handling and installation of all insulation materials shall be performed in strict accordance with the manufacturer's recommendations.
- 3.13 TOLERANCE**
- A. Substituted insulation materials shall provide thermal resistance within 10 percent at normal conditions, as materials indicated.

**3.14 DUCT INSULATION SCHEDULE:**

<u>Duct Type</u>	<u>Insulation Type</u>
Cold Supply Round	1 1/2" Insulation A
Hot Supply Round	1" Insulation A
Cold Supply Flat Oval	1 1/2" Insulation A
Hot Supply Flat Oval	1" Insulation A
Cold/Hot/or Combination Rectangular	1 1/2" Insulation B
Hot and Cold Combination Supply Round	2" Insulation C
Outside Air	1" Insulation B

**END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068



## SECTION 23 07 16

### EQUIPMENT INSULATION

#### PART 1 GENERAL

##### 1.00 The following sections are to be included as if written herein:

- A. Section 23 00 00 – Basic Mechanical Requirements
- B. Section 23 05 29 – Sleeves, Flashings, Supports and Anchors
- C. Section 23 05 53 – Mechanical Identification

##### 1.01 SECTION INCLUDES

- A. Equipment insulation
- B. Covering
- C. Breaching insulation

##### 1.02 RELATED SECTIONS

- A. Section 09 91 00 - Painting: Painting insulation covering

##### 1.03 REFERENCES

- A. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate
- B. ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded- Hot-Plate Apparatus
- C. ASTM C195 - Mineral Fiber Thermal Insulation Cement
- D. ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation
- E. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement
- F. ASTM C518 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
- G. ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation
- H. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
- I. ASTM C552 - Cellular Glass Block and Pipe Thermal Insulation
- J. ASTM C553 - Mineral Fiber Blanket and Felt Insulation
- K. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation
- L. ASTM C640 - Corkboard and Cork Pipe Thermal Insulation

- M. ASTM C921 - Properties of Jacketing Materials for Thermal Insulation
- N. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber
- O. ASTM E84 - Surface Burning Characteristics of Building Materials
- P. ASTM E96 - Water Vapor Transmission of Materials
- Q. NFPA 255 - Surface Burning Characteristics of Building Materials
- R. UL 723 - Surface Burning Characteristics of Building Materials

**1.04 SUBMITTALS**

- A. Submit under provisions of Section 23 00 00.
- B. Product Data: Provide product description, list of materials and thickness for equipment scheduled.
- C. Samples: Submit two samples of any representative size illustrating each insulation type.
- D. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.

**1.05 QUALITY ASSURANCE**

- A. Materials: Flame spread/smoke developed rating of 25/50 in accordance with NFPA 255.

**1.06 QUALIFICATIONS**

- A. Applicator: Company specializing in performing the work of this section with minimum three years experience.

**1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, protect and handle products to site under provisions of Section 23 00 00.
- B. Deliver materials to site in original factory packaging, labeled with manufacturer's density and thickness.
- C. Store insulation in original wrapping and protect from weather and construction traffic.
- D. Protect insulation against dirt, water, chemical, and mechanical damage.

**1.08 ENVIRONMENTAL REQUIREMENTS**

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

**PART 2 PRODUCTS**

**2.01 PUMPS AND FILTER HOUSINGS:**

- A. Each chilled water pump and filter housing shall be insulated as hereinafter specified.
- B. Contractor shall install dimensional standard cellular glass insulation, Pittsburgh Corning "FOAMGLAS". The "FOAMGLAS" "StrataFab System" may also be installed as appropriate. "FOAMGLAS" for higher than ambient temperature service shall be manufactured using Pittsburgh Corning Hydrocal B-11 as the joint adhesive between layers of material. Prior to application of any insulation, all metal surfaces shall be thoroughly cleaned. Regular "FOAMGLAS" insulation shall be applied to the piping with butt joints staggered and all joints tightly butted. The insulation shall be held in place using stainless steel bands. The bands shall be spaced at 12 inches on center. A jacket of aluminum or stainless steel shall be applied to the completed installation. The Longitudinal joint of the jacketing shall be placed with overlap directed to bottom of pipe. The jacketing shall be overlapped a minimum of 3 inches, and it shall be held in place using 3/4 inch bands applied at 12 inches on center. Note that the use of asphaltic compounds in higher-than-ambient temperature service is prohibited.
- C. Fitting insulation shall be applied in same manner as pipe application. Refer to piping insulation specification for proper guidance.
- D. The insulation thickness shall be as follows:

Temperature	<u>Thickness</u>
75°F to 150°F	2"
151°F to 300°F	2 1/2"
above 300°F	3"

- E. Securing of the jacket shall be made by the use of 1/2" x 0.016" aluminum or stainless steel bands and seals. The shields at support points shall be secured with 1/2" x 0.020" stainless steel bands and seals. Ferrous metal surfaces shall be primed with a red lead oxide primer. The metal jacketing and fitting covers shall be fabricated of 0.016" aluminum or stainless steel with a smooth finish.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that equipment has been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

**3.02 INSTALLATION**

- A. Install materials in accordance with manufacturer's instructions.
- B. Do not insulate factory insulated equipment.
- C. On exposed equipment, locate insulation and cover seams in least visible locations.
- D. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Secure insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

- E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- F. Insulated dual temperature equipment or cold equipment containing fluids below ambient temperature:
  - 1. Provide vapor barrier jackets, factory applied or field applied.
  - 2. Finish with glass cloth and vapor barrier adhesive.
  - 3. Insulate entire system.
- G. For insulated equipment containing fluids above ambient temperature:
  - 1. Provide standard jackets, with or without vapor barrier, factory applied or field applied.
  - 2. Finish with glass cloth and adhesive.
  - 3. For hot equipment containing fluids 140 degrees F or less, do not insulate flanges and unions, but bevel and seal ends of insulation.
  - 4. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions, including those at equipment, but label the insulation to indicate a concealed flange or union.
- H. Inserts and Shields:
  - 1. Application: Equipment 2 inches diameter or larger.
  - 2. Shields: Galvanized steel between hangers and inserts.
  - 3. Insert location: Between support shield and equipment and under the finish jacket.
  - 4. Insert configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
  - 5. Insert material: Heavy density insulating material suitable for the planned temperature range.
- I. Finish insulation at supports, protrusions, and interruptions.
- J. For equipment in mechanical equipment rooms or in finished spaces, finish with aluminum jacket.
- K. For exterior applications, provide vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal equipment.
- L. Cover cellular glass and cellular foam insulation with aluminum jacket.
- M. Do not insulate over any nameplate or ASME stamps. Bevel and seal insulation around such.
- N. Install insulation for equipment requiring access for maintenance, repair, or cleaning, in such a manner that it can be easily removed and replaced without damage.

- O. All piping, equipment, ductwork, all plenums including metal and masonry construction, fans, etc., shall be insulated as indicated on the Drawings, as specified herein, and as required for a complete system. In each case, the insulation shall be equal to that specified and materials applied and finished as described in these Specifications.
- P. All insulation shall be applied by mechanics skilled in this particular work and regularly engaged in such occupation. All insulation shall be applied in strict accordance with these Specifications and with factory printed recommendations on items not herein mentioned. Unsightly, inadequate, or sloppy work will not be acceptable, and all such work shall be removed and replaced as many times as necessary to achieve an acceptable installation.
- Q. All insulation, jacket, adhesives, mastics, sealers, etc., utilized in the fabrication of these systems shall meet NFPA for fire resistant ratings (maximum of 25 flame spread and 50 smoke developed ratings) and shall be approved by the insulation manufacturer for guaranteed performances when incorporated into their insulation system, unless a specific product is specified for a specific application, and is stated as an exception to this requirement. Certificates to this effect shall be submitted along with Contractor's submittal data for this section of the Specifications. No material may be used that, when tested by the ASTM E84-89 test method, is found to melt, drip or delaminate to such a degree that the continuity of the flame front is destroyed, thereby resulting in an artificially low flame spread rating.
- R. All surfaces to be insulated shall be clean and dry before applying the insulation. All sections of molded pipe covering shall be firmly butted together. Where an insulation covering is applied, it shall lap the adjoining section of insulation by at least three inches (3"). Where insulation terminates, it shall be neatly beveled and finished. No insulation shall be applied until the pipe, duct, etc., have been pressure tested and found tight. Piping, flexible connections, flanges, valves, strainers, and unions shall be covered unless specifically noted otherwise. Flexible connections on duct shall not be covered. All materials used shall be fire retardant or nonflammable. Refer to Section 15A.
- S. Where vapor barriers are required, the vapor barrier shall be on the outside. Extreme care shall be taken that the vapor barrier is unbroken. Joints, etc., shall all be sealed. Where insulation with a vapor barrier terminates, it shall be sealed off with the vapor barrier being continuous to the surface being insulated. Ends shall not be left raw.
- T. Extreme care shall be taken in covering high and medium pressure (high and medium pressure ductwork shall be all ductwork between the fan discharge and all mixing boxes) ductwork to insure the duct is not pierced with sheet metal screws or other fasteners. All high and medium pressure ducts in these specifications are classified as high velocity ductwork.
- U. Where specified, aluminum bands shall be used on piping insulation. The bands shall be applied three (3) to a section of pipe. Fittings, valves, etc., shall have bands on each side.
- V. Where canvas finish is specified, use Arabol lagging adhesive to prevent mildew in securing canvas. Do not use wheat paste. In addition, cover all canvas insulation with a fire retardant coating.
- W. For purpose of definition in this Specification: "concealed" areas are those areas which cannot be seen by the building occupants, and "exposed" areas are all areas which are exposed to view by the building occupants, including under counter and inside cabinet areas, plus all mechanical rooms.

- X. The handling and installation of all insulation materials shall be performed in strict accordance with the manufacturer's recommendations.

**END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

## SECTION 23 07 19

### PIPING INSULATION

#### **PART 1** GENERAL

##### **1.00** The following sections are to be included as if written herein:

- A. 23 00 00 -- Basic Mechanical Requirements
- B. 23 05 29 -- Sleeves, Flashings, Supports and Anchors
- C. 23 05 53 -- Mechanical Identification

##### **1.01** SECTION INCLUDES

- A. Piping insulation
- B. Jackets and accessories

##### **1.02** PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Section 21 13 13 - Fire Protection Piping: Placement of hangers and hanger inserts.
- B. Section 22 13 16 - Plumbing Piping: Placement of hangers and hanger inserts.
- C. Section 23 21 00 - Hydronic Piping: Placement of hangers and hanger inserts.
- D. Section 23 22 00 - Steam Piping: Placement of hangers and hanger inserts.

##### **1.03** RELATED SECTIONS

- A. Section 09 91 00 - Painting: Painting Insulation Jacket.

##### **1.04** REFERENCES

- A. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- B. ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded- Hot-Plate Apparatus.
- C. ASTM C195 - Mineral Fiber Thermal Insulation Cement.
- D. ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.
- E. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal
- F. ASTM C518 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- G. ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.
- H. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

- I. ASTM C547 - Mineral Fiber Preformed Pipe Insulation.
- J. ASTM C552 - Cellular Glass Block and Pipe Thermal Insulation.
- K. ASTM C578 - Preformed, Block Type Cellular Polystyrene Thermal Insulation.
- L. ASTM C585 - Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
- M. ASTM C591 - Rigid Preformed Cellular Urethane Thermal Insulation.
- N. ASTM C610 - Expanded Perlite Block and Pipe Thermal Insulation.
- O. ASTM C640 - Corkboard and Cork Pipe Thermal Insulation.
- P. ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.
- Q. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.
- R. ASTM D1667 - Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Closed Cell Foam).
- S. ASTM D2842 - Water Absorption of Rigid Cellular Plastics.
- T. ASTM E84 - Surface Burning Characteristics of Building Materials.
- U. ASTM E96 - Water Vapor Transmission of Materials.
- V. NFPA 255 - Surface Burning Characteristics of Building Materials.
- W. UL 723 - Surface Burning Characteristics of Building Materials.

#### **1.05 SUBMITTALS**

- A. Submit under provisions of Section 23 00 00.
- B. Product Data: Provide product description, list of materials 'k' value, 'R' value, mean temperature rating, and thickness for each service, and locations.
- C. Samples: When requested, submit two samples of any representative size illustrating each insulation type.
- D. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.

#### **1.06 QUALITY ASSURANCE**

- A. All insulation, jacket, adhesives, mastics, sealers, etc., utilized in the fabrication of these systems shall meet NFPA for fire resistant ratings (maximum of 25 flame spread and 50 smoke developed ratings) and shall be approved by the insulation manufacturer for guaranteed performances when incorporated into their insulation system, unless a specific product is specified for a specific application, and is stated as an exception to this requirement. Certificates to this effect shall be submitted along with Contractor's submittal data for this section of the Specifications. No material may be used that, when tested by



the ASTM E84-89 test method, is found to melt, drip or delaminate to such a degree that the continuity of the flame front is destroyed, thereby resulting in an artificially low flame spread rating.

- B. All surfaces to be insulated shall be clean and dry before applying the insulation. All sections of molded pipe covering shall be firmly butted together. Where an insulation covering is applied, it shall lap the adjoining section of insulation by at least three inches (3"). Where insulation terminates, it shall be neatly beveled and finished. No insulation shall be applied until the pipe, duct, etc., have been pressure tested and found tight. Piping, flexible connections, flanges, valves, strainers, and unions shall be covered unless specifically noted otherwise. Flexible connections on duct shall not be covered. All materials used shall be fire retardant or nonflammable. Refer to Section 23 00 00.
- C. All piping, equipment, ductwork, all plenums including metal and masonry construction, fans, etc., shall be insulated as indicated on the Drawings, as specified herein, and as required for a complete system. In each case, the insulation shall be equal to that specified and materials applied and finished as described in these Specifications.
- D. To be considered, alternate materials shall have equivalent thermal and moisture resistance of the specified materials.

#### **1.07 QUALIFICATIONS**

- A. All insulation shall be applied by mechanics skilled in this particular work and regularly engaged in such occupation.
- B. All insulation shall be applied in strict accordance with these Specifications and with factory printed recommendations on items not herein mentioned. Unsightly, inadequate, or sloppy work will not be acceptable, and all such work shall be removed and replaced as many times as necessary to achieve an acceptable installation. The company performing the work of this section shall have a minimum of three years experience specializing in the trade.

#### **1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, protect, and handle products to site under provisions of Section 23 00 00.
- B. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product thermal ratings and thickness.
- C. Store insulation in original wrapping and protect from weather and construction traffic. Protect insulation against dirt, water, chemical, and mechanical damage.

#### **1.09 ENVIRONMENTAL REQUIREMENTS**

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.
- C. All insulation materials to be asbestos free.

## **PART 2 PRODUCTS**

### **2.01 DOMESTIC HOT AND COLD WATER**

- A. All domestic hot and cold water lines in buildings, including valves, strainers, unions, flanges, etc., except where specifically noted to the contrary, shall be insulated.
- B. All domestic cold water lines shall be insulated as scheduled with preformed fiberglass insulation with a factory applied All Service Jacket, vapor sealing all joints, and factory performed fittings with vapor seal, or a flexible, "25-50" rated, closed cell elastomeric thermal insulation such as "Self Seal Armaflex 2000". Elastomeric products shall be supplied in a pre-slit tubular form with a pressure sensitive adhesive system for closure and vapor sealing of the longitudinal joint. All elastomeric insulating products shall be guaranteed not to react with copper piping. Valves shall be insulated with mitered pipe covering with voids filled with glass fiber blanket insulation. Valves and fittings shall be vapor sealed with a water base asphaltic emulsion. Fittings on concealed insulation shall be built up to the thickness of adjacent insulation with glass fiber fitting wrap and shall be finished with Glasfab tape embedded in vapor barrier emulsion. Exposed fitting insulation shall be built up to same thickness as adjoining pipe insulation with one coat cement and after drying shall be finished with a white vapor seal and canvas jacket secured with "Arabol" adhesive and be suitable for painting. Seams in jacket shall be placed in the least noticeable locations. Where seams, joint or fittings are rough they shall be covered with an application of insulating cement troweled on smoothly before the canvas is applied with Arabol adhesive. The canvas must be free of wrinkles and have a smooth, neat appearance.
- C. All domestic hot water piping systems shall be insulated as specified above for cold water except the vapor barrier may be deleted and the lap and butt joints secured with staples and a field applied adhesive (self sealing lap and butt joints alone are not acceptable). The insulation thickness shall be as scheduled. Where service temperature exceeds 250°F, insulation shall contain high temp binders.
- D. The only domestic hot and cold water piping that will not require insulation are the exposed runouts under non-handicap plumbing fixtures. Where pipe chases are tight, adequate provision shall be made at the rough in stage utilizing offset fittings or other means (except springing the pipe) to insure that insulation can be applied throughout the length of the pipe.

### **2.02 CHILLED WATER PIPING - BUILDINGS**

- A. Chilled Water Piping - "FOAMGLAS" as manufactured by the Pittsburgh Corning Corporation or "INSUL-PHEN" as manufactured by Resolco, Inc. and shall be installed on chilled water lines in tunnels and in buildings up to the building circulating pump. The "FOAMGLAS" "StrataFab System" may also be installed on larger pipe sizes as appropriate. Prior to application of any insulation, all metal surfaces shall be thoroughly cleaned. The metal shall then be primed with an asphaltic primer consisting of one (1) coat of Foster No. 60-26 Primer or Pittcote 300 Primer. Cleaning and priming specified in this paragraph is not included in requirements for "Cleaning and Painting" specified in other sections of the Specifications. Regular "FOAMGLAS" insulation shall be applied to the piping with butt joints staggered and all joints tightly butted and sealed with a ¼" bead of joint sealer ½" from outside edge. Hold in place with 14 gauge copper clad wire 9" o.c. After insulation has been wired in place, a 1/16" minimum thick, 3" wide band of asphaltic vapor seal mastic shall be brushed or troweled on the outside of the "FOAMGLAS" insulation at the approximate location of the aluminum bands. (Note that the asphaltic material specified in this paragraph is intended to be an exception to the flame spread and smoke generation limitations found elsewhere in this specification.) An aluminum jacketing 0.016" thickness equal to Premetco precast, pre rolled Z-lock Kraft paper lined pipe covering with zee type closure and ¾" wide snap straps with permanent sealant shall then be fitted to O.D. of

insulation and applied over the insulated pipe with 3" end and side caps secured with aluminum bands on 12" centers. Longitudinal joint of aluminum jacketing shall be placed with overlap directed to bottom of pipe. Any voids in the completed installation of the insulation shall not be filled with vapor seal coating but shall be eliminated by refitting or replacing insulation.

- B. "FOAMGLAS" or "INSUL-PHEN" insulation on flanges, valves and other fitting shall consist of prefabricated fitting covers of the same thickness as specified for adjoining pipe insulation.
- C. Fitting covers shall be applied in same manner as pipe application except that 16 gauge aluminum wire may be used to secure screwed fitting covers. Protruding metal parts (such as valve stems) shall be completely sealed off. Fitting cover jacketing shall be equal to Gasco, Papco or RPR Metals prefabricated fitting covers of 0.016" paper coated aluminum, secured as recommended by the manufacturer.
- D. The insulation thickness shall be as scheduled.
- E. "FOAMGLAS" or "INSUL-PHEN" installed inside the building downstream of the blending station shall be insulation with factory applied Class I, Fire Rated, Kraft-Aluminum, vapor barrier jacketing as manufactured by Pittsburgh Corning. It shall be applied in strict accordance with the manufacturer's recommendations after the pipe has been primed with one (1) coat of Foster No. 60-26 Primer or Pittcoat 300 Primer. (Note that the asphaltic material specified in this paragraph is intended to be an exception to the flame spread and smoke generation limitations found elsewhere in this specification.) It will be necessary to include expansion joints at regular intervals on dual temperature service. Thickness shall be as scheduled.
- F. Fitting covers shall be built up of shaped segments of "FOAMGLAS" or "INSUL-PHEN." These fitting covers shall be adhered in place using "Foster No. 30-35 80" water based vapor seals, then smoothly covered by a one-quarter inch (1/4") thick application of one coat white insulating cement. All this piping and fittings shall be finished with an eight ounce canvas jacket neatly applied using Arabol adhesive.
- G. Valves, fittings, etc., in congested areas around coil and heat exchanger equipment, etc., shall be insulated by building up fitting segments and pre-molded sections, plus white vapor seal mastic, plus Manville No. 301 finishing cement to smooth surfaces, plus canvas applied and sized for painting with fire resistant adhesive. In addition, all manufactured vapor barrier jacketing in mechanical rooms and finished spaces shall be finished with canvas applied and sized for painting with fire resistant adhesive.
- H. No chilled water pipe supporting structures shall pierce the insulation except as anchor points as shown on the Drawings. At these points, the anchor member shall occur on the bottom of the piping to allow condensation to drain.
- I. The application of the protective shields at rack and guide points in tunnels and in central chilling stations shall be as detailed on the accompanying Drawings.
- J. All insulation joints (longitudinal and butt) shall be buttered with vapor sealant mastic then pressed firmly together.

### **2.03 CONDENSATE DRAIN PIPING**

- A. Condensate drain piping from fan and coil units, coil banks, drinking fountain refrigeration units, and other items of piping or equipment subject to condensation forming on the surface shall be insulated with a "25-50" rated, closed cell elastomeric thermal insulation. Elastomeric products shall be supplied in a pre-slit tubular form with a pressure sensitive

adhesive system for closure and vapor sealing of the longitudinal joint. All elastomeric insulating products shall be guaranteed not to react with copper piping.

- B. Drain piping from mechanical rooms, and other areas potentially receiving chilled water or condensate from air handlers, shall be similarly insulated for a minimum of 15 feet from the floor drains receiving the cold fluid.

## **2.04 PROTECTIVE JACKETING**

- A. Provide protective jacketing as described elsewhere.
- B. Jacketing and fitting covers shall be .016 aluminum smooth as manufactured by Premetco or Childers. The jacket shall be pre-cut, pre-rolled, and lapped a minimum of two inches (2") in all directions to shed water. The metal shall be secured at each joint with a minimum of one each (1 ea.) 3/4" wide .020 aluminum or stainless steel band and seal. The metal jacketing and fitting covers shall be fabricated of 0.016" aluminum or stainless steel with a smooth finish.
- C. In indoor applications, Proto Corp. LoSmoke PVC jacketing and fitting covers may be used. Material shall have 25/50 rating and shall be limited to piping systems operating at 140 degrees or below.

## **2.05 EXPANSION JOINTS**

- A. Where expansion bends occur in the lines, a two foot (2') double layer contraction joint shall be provided in the main line starting two feet from the end of the main line ells on both sides of the expansion loop. Contraction joints shall consist of two 1-1/2" thick x 24" long pipe covering cuts into 17-1/4" and 6" lengths to provide a 3/4" space by 10-1/4". A slip joint mastic (Pittseal III) shall be placed between layers from the 3/4" space provided on the inside layer to the 3/4" space on the outside layer.
- B. The 3/4" space on inside layer shall be filled with mineral wool loose fill and the 3/4" space on the outer layer shall also be filled with same loose fill and joint sealer pressed 1/2" deep into space for sealing (Pittseal III). Around the outside layer at the 3/4" space, there shall be wrapped a 4" wide piece of glass fabric and sealed down with vapor seal mastic. On pipe sizes smaller than aforementioned, the same contraction joint shall be provided using one inch (1") thick "FOAMGLAS" or "INSUL-PHEN" pipe covering for the inner layer. On two inch (2") IPS, both inner and outer layer shall be 1" thick "FOAMGLAS" or "INSUL-PHEN".
- C. The joint and vapor seal mastic shall be Pittsburgh Corning Corporation Pittcote 300. (Note that the asphaltic material specified in this paragraph is intended to be an exception to the flame spread and smoke generation limitations found elsewhere in this specification.
- D. The slip joint sealer shall be Pittsburgh Corning Corporation's Pittseal III.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

### **3.02 INSTALLATION**

- A. Install materials in accordance with manufacturer's instructions in the absence of specific instruction herein.

- B. On exposed piping, locate insulation and cover seams in least visible locations, but not higher than at the side of the pipe at the "90°" position, with the seam lapped such that the lap is directed down.
- C. Insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature: Vapor barriers are required. The vapor barrier shall be on the outside. Extreme care shall be taken that the vapor barrier is unbroken. Joints, etc., shall be sealed. Where insulation with a vapor barrier terminates, it shall be sealed off with the vapor barrier being continuous to the surface being insulated. Ends shall not be left raw.
  - 1. Provide vapor barrier jackets, factory applied or field applied.
  - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe.
  - 3. Finish with glass cloth and vapor barrier adhesive.
- D. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
- E. For insulated pipes conveying fluids above ambient temperature:
  - 1. Provide standard jackets, with or without vapor barrier, factory applied or field applied.
  - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
- F. If PVC fitting covers are used they shall have 25/50 rating.
- G. For hot piping conveying fluids 140°F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- H. For hot piping conveying fluids over 140°F, insulate flanges and unions, including those at equipment, but label the insulation to indicate a concealed flange or union. See 2.04K.

**3.03 INSERTS, SUPPORTS and SHIELDS**

- A. Application: Piping 3/4 inch diameter or larger for all systems except direct buried.
- B. Shields: Install between pipe hangers or pipe hanger rolls and inserts. Hangers shall be on the outside of the insulation and shall not be in contact with the pipe. Curved metal shields shall be used between the hangers or support points and the bottom of the insulated pipe for insulated pipes 3/4" and larger. Curved metal shields shall be designed to limit the bearing stress on the insulation to 35 psi and shall be curved to fit up to mid-perimeter of the insulated pipe. Shields shall be made of galvanized iron, or black iron painted on both sides with two coats of aluminum paint. Required metal shield sizes are as follows:

Nominal IPS	Metal Thickness	Lengths of Shield
up thru 2"	14 gauge	12"
thru 6"	12 gauge	16"
and above	10 gauge	20"

- C. Insert Location: Between support shield and piping and under the finish jacket.
- D. Insert Configuration: Minimum 2" inches longer than length of shield, of same thickness and contour as adjoining insulation; may be factory fabricated.

- E. Insert Material: Heavy density insulating material suitable for the planned temperature range, and the weight of the pipe.
- F. The shields at support points shall be secured with ½" x 0.016" stainless steel bands and seals.
- G. Finish insulation at supports, protrusions, and interruptions.
- H. The application of the protective shields at rack and guide points in tunnels and in central chilling stations shall be as detailed on the accompanying Drawings.
- I. In lieu of the above the following system of support may be used:
  1. At the pipe support positions, the insulation and vapor barrier shall be continuous and shall not be punctured by the support. The insulation at the support shall be the full circumference of 5lbs/ft<sup>3</sup> INSUL-PHEN Foam material to withstand the bearing loads transmitted from the pipe to the support, it shall extend for at least 1" on either side of the support to allow sealing of the joints with the pipe insulation jacket.
  2. The load bearing insulation at the support shall be capable of withstanding the maximum static compressive loads generated by pipe supported at the centers shown in Table 1.

Variations: Pipe loads greater than those generated at the support centers shown in Table 1 shall be referred to the manufacturer to establish the length and density of the insulated support block. The support centers are based on the weight of Sch 80 pipe filled with water and covered with 1" thickness of 2.2 lbs/ft<sup>3</sup> standard insulation including FSK/ASJ vapor barrier.

Table 1 K Block Support Centers

Nominal Pipe Size	3/4	1	1 1/4	2	2 1/2	3	4	6	8	10	12	14	16	18	20	24
Max support centers (feet)																
Sch 80 pipe filled with water covered with 1" of Standard Insulation	6.5	6.5	6.5	10	10	10	10	10	14	14	14	20	20	20	20	20
Metal Saddle Gauge (Galvanized Steel)	22	22	22	20	20	20	16	14	14	14	14	14	114	14	14	14
Length of K Block (inches)	6	6	6	6	6	6	6	9	9	9	9	9	9	12	12	12

1. The Insulation at supports shall be a Kooltherm K Block. K Blocks shall be faced with factory applied FSK/ASJ vapor barrier and fitted with a galvanized steel 180° saddle bonded to the bottom section of the K Block, for all pipe sizes 1 1/2" and larger.
2. The vapor barrier shall be completed by the use of a FSK/ASJ overlap and factory applied self-seal lap tape and sealed with vapor barrier adhesive.
3. At all support positions, other than those where the insulated pipe support block is surrounded by a clip or saddle in direct contact with the block, a block designed to accept the loads generated by the pipe shall be presented to the engineer for approval. e.g. Of the type Kooltherm products K Block. Ref:- Kooltherm sketch 106/2c for use with Roller or flat beam support.

4. In all cases where roller supports are used the length of the insulation and the wearing plate where fitted shall extend beyond the limits of the pipe movement.
- 3.04 For heat traced piping, insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
- 3.05 Where canvas finish is specified, use Arabol lagging adhesive to prevent mildew in securing canvas. Do not use wheat paste. In addition, cover all canvas insulation with a fire retardant coating.
- 3.06 For purpose of definition in this Specification: "concealed" areas are those areas which cannot be seen by the building occupants, and "exposed" areas are all areas which are exposed to view by the building occupants, including under counter and inside cabinet areas, plus all mechanical rooms.
- 3.07 Self Sealing Lap and butt joints will not be acceptable as the only seal on piping insulation joints. Self Sealing Lap and butt joints may be utilized only if the joints are additionally secured with field applied vapor barrier adhesive (on piping Systems requiring vapor barriers) or staples and field applied adhesive (on piping system which do not require a vapor barrier jacket). Mechanical fasteners shall be used whenever possible to assure permanent installation.
- 3.08 Insulation minimum thickness shall be as scheduled; however, additional thickness shall be provided to prevent condensation on the cold surfaces and to provide a maximum exterior insulation surface of 140°F on the hot surfaces.
- 3.09 Special Protection: All insulated piping in the mechanical rooms within 8'-0" of the floor shall be encased in a protective jacket, and where applicable, finish at top with nickel-plated brass flange plate with set screws or end joint sealing butt strips.
- 3.10 All exposed outdoor piping shall have metal jacket.
- 3.11 Fitting insulation shall be applied in same manner as pipe application. Protruding metal parts (such as valve stems) shall be completely sealed off. Fitting cover jacketing shall be equal to Gasco, Pabco or RPR Metals prefabricated fitting covers of 0.016" paper coated aluminum, secured as recommended by the manufacturer.
- 3.12 Valves, fittings, etc., in congested areas around coil and heat exchanger equipment, etc., shall be insulated by building up fitting segments and pre-molded sections as necessary.
- 3.13 No pipe supporting device (other than guides or anchors attached directly to the pipe) shall penetrate the insulation.
- 3.14 PAINTING**
- A. All exposed insulation shall be prepared to receive painting specified under Section 09 91 00.
- B. The pipe primer shall be Pittsburgh Corning Corporation Pittcote 300.

**Insulation 'R' Value Schedule (R = thickness / k)**

Service °F	Oper Temp	'k' @ Mean Temp °F	& less	Min. R value for each Pipe Size				
				1" to 2"	1-1/4" to 4"	2-1/2" 6"	5" & over	8" &
Cold (6)40-55		.25 @ 75	2.0	3.0	4.0	4.0	4.0	

(6) Ch. Water; Dom. Cold Water; Storm; Cold condensate

Minimum 'R' does not consider water vapor transmission and condensation. Additional insulation and/or vapor retarders may be required to limit water vapor transmission and condensation under extreme conditions.

A minus 15 percent tolerance, on the insulation performance listed shall be permitted for manufacturers' standard insulation systems.

In non-conditioned mechanical rooms and all crawl spaces, insulation shall prevent formation of surface condensation under conditions of 95°F, 95%RH, and zero wind speed. Provide manufacturer's certification of this performance on submittal data.

**END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068



## SECTION 23 09 23

### DIRECT DIGITAL CONTROL SYSTEMS

#### PART 1 GENERAL

**1.00 RELATED WORK** The following sections are to be included as if written herein:

- A. Section 23 00 00 – Basic Mechanical Requirements
- B. Section 23 05 29 – Sleeves, Flashings, Supports and Anchors
- C. Section 23 05 53 – Mechanical Identification

#### 1.01 SECTION INCLUDES

- A. Control Equipment
- B. Software

#### 1.02 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Section 23 33 00 - Ductwork Accessories: Installation of automatic dampers, smoke detectors. Connection of damper end switches.

#### 1.03 REFERENCES

- A. ASHRAE 85 - Automatic Control Terminology for Heating, Ventilating, Air Conditioning
- B. ASME MC85.1 - Terminology for Automatic Control
- C. NEMA EMC1 - Energy Management Systems Definitions

#### 1.04 SYSTEM DESCRIPTION

- A. Automatic temperature control field monitoring and control system using field programmable micro-processor based units with future communications to the existing JCI MetaSys BCAS.]
- B. Central and remote hardware, software, and interconnecting wire and conduit.
- C. Terminal unit controls for variable air volume terminals shall be DDC with electric actuators unless indicated otherwise.
- D. Damper Motors and Valve Operators: Electric.

#### 1.06 SUBMITTALS

- A. Submit under provisions of Section 23 00 00.
- B. Shop Drawings:

1. Trunk cable schematic showing programmable control unit locations, and trunk data conductors.
  2. List of connected data points, including connected control unit and input device.
  3. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
  4. System configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
  5. Descriptive data and sequence of operation of operating, user, and application software.
- C. Product Data: Provide data for each system component and software module.
- D. Manufacturer's Installation Instructions: Include for all manufactured components.

#### **1.07 PROJECT RECORD DOCUMENTS**

- A. Accurately record actual location of control components, including panels, thermostats, and sensors.
- B. Revise shop drawings to reflect actual installation and operating sequences.
- C. Include data specified in "Submittals" in final "Record Documents" form.

#### **1.08 OPERATION AND MAINTENANCE DATA**

- A. Include interconnection wiring diagrams complete field installed system with identified and numbered, system components and devices.
- B. Include keyboard illustrations and step-by-step procedures indexed for each operator function.
- C. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

#### **1.09 QUALIFICATIONS**

- A. Manufacturer: Johnson Controls MetaSys to match existing Campus Controls.
- B. Installer: Johnson Controls to match existing Campus Controls.

#### **1.10 COORDINATION**

- A. Ensure installation of components is complementary to installation of similar components in other systems.
- B. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.
- C. Ensure system is completed and commissioned.

**1.11 WARRANTY**

- A. Provide warranty as specified in Division 1.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Manufacturer: Johnson Controls MetaSys to match existing Campus Controls.

**2.02 INPUT/OUTPUT SENSORS**

- A. Temperature:
  - 1. Resistance temperature detectors with resistance tolerance of plus or minus 0.1 percent at 21 degrees C, interchangeability less than plus or minus 0.2 percent C, time constant of 13 seconds maximum for fluids and 200 seconds maximum for air. Sensors shall match the current sensors being installed in the building.
  - 2. Measuring current maximum 5 MA with maximum self-heat of 0.017 degrees C/MW in fluids and 0.008 degrees C/MW in fluids and 0.008 degrees C/MW in air.
  - 3. Provide 3 lead wires and shield for input bridge circuit.
  - 4. Use insertion elements in ducts not affected by temperature stratification or smaller than one square meter. Use averaging elements where larger or prone to stratification sensor length 2.5 m or 5 m as required.
  - 5. Insertion elements for liquids shall be with brass socket with minimum insertion length of 2-1/2 inches (60 mm).
  - 6. Supply room sensors with locking cover.]
  - 7. Provide outside air sensors with watertight inlet fitting, shielded from direct rays of sun.
- B. Humidity Sensors:
  - 1. Elements: Accurate within 5 percent full range with linear output.
  - 2. Room Sensors: With locking cover, span of 10 to 60 percent relative humidity. Sensors shall match the current sensors being installed in the building.
  - 3. Duct and Outside Air Sensors: With element guard and mounting plate, range of 0 - 100 percent relative humidity.
- C. Static Pressure Sensors:
  - 1. Unidirectional with ranges not exceeding 150 percent of maximum expected input.
  - 2. Temperature compensated with typical thermal error or 0.06 percent of full scale in temperature range of 40 to 100 degrees F (5 to 40 degrees C).
  - 3. Accuracy: One percent of full scale with repeatability 0.3 percent.

4. Output: 0 - 5 vdc with power at 12 to 28 vdc.
- D. Equipment Operation Sensors:
1. Status Inputs for Fans: Differential pressure switch with adjustable range of 0 to 5 inches wg (0 to 1250 Pa).
  2. Status Inputs for Pumps: Differential pressure switch piped across pump with adjustable pressure differential range of 8 to 60 psi (50 to 400 kPa).
  3. Status Inputs Where Differential Pressure Sensing is Impractical: Current sensitive relay with current transformers, adjustable and set to 175 percent of rated motor current.
- E. Damper Position Indication: Potentiometer mounted in handbox enclosure with adjustable crank arm assembly connected to damper to transmit 0 - 100 percent damper travel.

## **2.03 OPERATING SYSTEM SOFTWARE**

- A. Johnson Controls MetaSys.
1. Functionality and graphics shall match existing DDC/BCAS controls in the building.
  2. Identify points with unique, structured point identifier reflecting "specific area" or "specific system", and "specified point".
- B. Operator Access Control: Restrict any operator commands through use of software password.
- C. Information Access: Obtain point status information from any designated output device with access command. Point status consists of point identification, numerical value (analog points) and associated engineering units, and individual function label indicating that point is on or off or in Alarm Normal condition. Output includes date and time of execution.
- D. Point Display: Video display includes status of single point or group of points with high and low limits (if applicable). Refresh display at least every 20 seconds.
- E. Alarm summary includes status of points in Alarm condition.
- F. Off-normal summary includes status of points in Off-Normal condition.
- G. Alarm Reporting:
1. Alarm outputs contain descriptor, point identification, point data, engineering units, and date and time.
  2. Print on line changeable message for each alarm point specified, immediately.
  3. Display alarm reports on video. Display multiple alarms in order of occurrence.
  4. Inhibit reporting of associated analog and binary alarms upon HVAC system shutdown. Upon restart, inhibit alarm reporting for operator pre-determined time.
  5. Operator specifies if alarm required acknowledgement.
- H. Advisories:

1. Lockout summary which contains status of points in locked out condition.
  2. Continuously interrogate system hardware and programmable control units for failure or tampering and report if operational or not operational.
  3. Power failure detection, time and date.
  4. System communication failure with operator device, field interface unit, point, programmable control unit.
- I. Power Failure Motor Restart: Provide program to restore systems to normal operating conditions following power outage, and to enforce emergency operating conditions during power outage. Automatically restart loads to correct operating condition if normal or emergency power is available.

## **2.04 BASIC OPERATING FEATURES**

### **A. Binary Capabilities:**

1. Monitor binary sensors, continuously storing present contact condition in memory.
2. Indicate if point is off-normal, in alarm, or off-line.
3. Program output points for Open/Closed, Test/Reset, Start/Stop.
4. Feedback Start/Stop points. Employ point unique, feedback delay timer to temporarily suppress alarm reporting after input to allow time for response.
5. Output advisory message if response is not as commanded.
6. Hold points in present operating condition if controls power failure occurs.

### **B. Analog Capabilities:**

1. Measure, transduce, transmit and display analog values.
2. Express analog point values in proper engineering units, displaying with up to six significant digits.
3. Have sensor to readout accuracy of plus or minus 0.5 degrees F (0.28 degrees C).
4. Use English system of measurement.
5. Provide for operator designated ranges either linear, series of linear approximations, split ranges, or square root extractions of exponential functions.
6. Compare analog read to high and low limits and annunciate Alarm or Off-Normal condition.
7. Output alarm, including point identification current value and associated engineering units, high or low value, and time and date.

8. Automatically disable alarm reporting upon associated system shutdown. Allow sufficient time to return to normal operating conditions before allowing alarm reporting.
  9. Provide limit and differential summary.
- C. Analog Point Adjust:
1. Remotely adjust controller set points or dampers. Automatically adjust points based upon preselected time or value.
  2. Employ feedback so that if point fails to respond, responds with wrong value, or drifts from set point value by plus or minus 2 percent, output alarm message. Employ feedback delay timer to temporarily suppress alarm reporting after input to allow time for response.
  3. Hold points in present operating condition if controls power failure occurs.
- D. Automatic Alarm Lockout: Automatically inhibit alarm reporting of analog and binary points upon associated system shutdown. Inhibit reporting for operator predetermined time, upon restart of HVAC systems.

## **2.05 HVAC CONTROL PROGRAMS**

- A. General:
1. Support English units of measurement
  2. Identify each HVAC Control system

## **2.06 PROGRAMMING APPLICATION FEATURES**

- A. Trend Point:
1. Provide to match existing BCAS in building.
- B. Alarm Messages:
1. Provide to match existing BCAS in building.
- C. Interlocking:
1. Permit events to occur, based on changing condition of one or more associated master points.
  2. Binary contact, high/low limit of analog point or computed point shall be capable of being utilized as master. Same master may monitor or command multiple slaves.
  3. Operator commands:
    - a. Define single master/multiple master interlock process.
    - b. Define logic interlock process.
    - c. Lock/unlock program.

- d. Enable/disable interlock process.
- e. Execute terminate interlock process.
- f. Request interlock type summary.

**2.07 UNITARY CONTROLLERS**

- A. Terminal Unit Controllers:
  - 1. Provide DDC controllers with integral electric damper operators to match current terminal unit DDC controllers being installed in the building.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install electrical work in accordance with Section 26 05 00. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.
- C. Provide with 120V AC, 15 amp control power circuit to each programmable control unit.

**3.02 MANUFACTURER'S FIELD SERVICES**

- A. Prepare and start systems under provisions of Division 1.
- B. Start-up and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.

**3.03 DEMONSTRATION**

- A. Provide systems demonstration under provisions of Division 1.
- B. Demonstrate complete and operating system to Owner.

**END OF SECTION**

E&C Engineers & Consultants, Inc.  
TX Firm Registration No: F-003068

This Page is Intentionally Blank



## **SECTION 23 20 00**

### **HVAC PUMPS**

#### **PART 1 GENERAL**

##### **1.00 The following sections are to be included as if written herein:**

- A. Section 23 00 00 – Basic Mechanical Requirements
- B. Section 23 05 29 – Sleeves, Flashings, Supports and Anchors
- C. Section 23 05 53 – Mechanical Identification

##### **1.01 WORK INCLUDED**

- A. Base mounted pumps

##### **1.02 RELATED WORK**

- A. Section 23 05 13 - Motors
- B. Section 21 05 48 - Vibration Isolation
- C. Section 23 07 19 - Piping Insulation
- D. Section 23 07 16 - Equipment Insulation
- E. Section 23 21 00 - Hydronic Piping
- F. Section 23 06 20.13 - Hydronic Specialties

##### **1.03 REFERENCES**

- A. ANSI/UL 778 - Motor Operated Water Pumps

##### **1.04 QUALITY ASSURANCE**

- A. Manufacturer: Company specializing in manufacture, assembly, and field performance of pumps with minimum three years experience.
- B. Alignment: Base mounted pumps shall be aligned by qualified millwright and alignment certified.

##### **1.05 SUBMITTALS**

- A. Submit shop drawings and product data under provisions of Section 23 00 00.
- B. Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
- C. Submit manufacturer's installation instructions under provisions of Section 23 00 00

## **1.06 OPERATION AND MAINTENANCE DATA**

- A. Submit operation and maintenance data under provisions of Section 23 00 00.
- B. Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

## **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to site under provisions of Section 23 00 00.
- B. Store and protect products under provisions of Section 23 00 00.

## **1.08 EXTRA PARTS**

- A. Provide one extra set of mechanical seals for pumps under provisions of Section 23 00 00.

## **PART 2 PRODUCTS**

### **2.01 ACCEPTABLE MANUFACTURERS**

- A. ITT Allis-Chalmers
- B. ITT Bell & Gossett
- C. Buffalo Forge
- D. Aurora
- E. Taco
- F. Paco
- G. Substitutions: Under provisions of Section 23 00 00

### **2.02 IN-LINE CENTRIFUGAL PUMPS:**

- A. Provide circulating pumps with all-bronze construction of the size, type, and capacity scheduled or shown on the Drawings. Pumps shall be fitted with a dynamically balanced brass enclosed type impeller with mechanical seal. Mechanical seal shall be Type 1 or Type 2 material, Code BP-1D1 as manufactured by John Crane Company or an approved equal, suitable for service specified. Motor shall have a maximum speed of 1750 rpm. Pumps, casings, flanges, and seals shall be suitable for operation with the working pressures and temperatures indicated. The scheduled working pressure applies to the entire pump assembly.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install pumps in accordance with manufacturer's instructions.
- B. Provide access space around pumps for service. Provide no less than a minimum of three feet, not including piping and piping appurtenances.

- C. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 15 percent of midpoint of published maximum efficiency curve.
- D. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close coupled or base mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches and over. Refer to Section 23 05 48.
- E. Provide line sized shut-off valve (ball or butterfly) and strainer on pump suction, and line sized soft seat check valve and balancing (ball or butterfly with memory stop) valve on pump discharge.
- F. Provide air cock and drain connection on horizontal pump casings.
- G. Provide drains for bases and seals, piped to and discharging into floor drains.
- H. Lubricate pumps before start-up.
- I. Alignment: A qualified millwright shall check, align and certify pumps. A reverse alignment procedure utilizing laser instruments shall be used. Alignment shall be performed in both hot and cold operating extremes. The maximum parallel and angular misalignment shall not exceed .002 inch. Record and deliver copies of the alignment report to the Owner's RCM and include copy of the report in the O&M Manual.
- J. Vibration Testing: Vibration velocity readings shall be taken at all bearing locations of all pumps. Pumps driven by variable speed drives shall be tested throughout their range of speeds. Vibration shall not exceed 0.15 inch/second (peak). Record and deliver copies of the test report to Owner's RCM and include report in the O&M Manual.

**END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

This Page is Intentionally Blank

**SECTION 23 20 00.A**  
**PIPING, VALVES AND FITTINGS**

**PART 1 GENERAL**

**1.00 The following sections are to be included as if written herein:**

- A. Section 23 00 00 – Basic Mechanical Requirements
- B. Section 23 05 29 – Sleeves, Flashings, Supports and Anchors
- C. Section 23 05 53 – Mechanical Identification

**1.01 SECTION INCLUDES**

- A. Pipe and Pipe Fittings
- B. Valves

**1.02 RELATED SECTIONS**

- A. Section 23 05 16 - Expansion Compensation
- B. Section 23 05 48 - Vibration Isolation
- C. Section 23 07 19 - Piping Insulation

**1.03 REFERENCES**

- A. AGA - American Gas Association
- B. ANSI B31.1 - Power Piping
- C. ANSI B31.2 - Fuel Gas Piping
- D. ANSI B31.4 - Liquid Petroleum Transportation Piping Systems
- E. ANSI B31.9 - Building Service Piping
- F. ASME - Boiler and Pressure Vessel Code
- G. ASME Sec. 9 - Welding and Brazing Qualifications
- H. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800
- I. ASME B16.3 - Malleable Iron Threaded Fittings
- J. ASME B16.4 - Cast Iron Threaded Fittings Class 125 and 250
- K. ASME B16.18 - Cast Bronze Solder-Joint Pressure Fittings
- L. ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings

- M. ASME B16.23 - Cast Copper Alloy Solder-Joint Drainage Fittings - DWV
- N. ASME B16.26 - Cast Bronze Fittings for Flared Copper Tubes
- O. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
- P. ASME B16.32 - Cast Copper Alloy Solder-Joint Fittings for Solvent Drainage Systems
- Q. ASTM A47 - Ferric Malleable Iron Castings
- R. ASTM A135 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless
- S. ASTM A74 - Cast Iron Soil Pipe and Fittings
- T. Not Used
- U. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
- V. ASTM B32 - Solder Metal
- W. ASTM B42 - Seamless Copper Pipe
- X. ASTM B43 - Seamless Red Brass Pipe
- Y. ASTM B75 - Seamless Copper Tube
- Z. ASTM B88 - Seamless Copper Water Tube
- AA. ASTM B251 - Wrought Seamless Copper and Copper-Alloy Tube
- BB. ASTM B302 - Threadless Copper Pipe (TP)
- CC. ASTM B306 - Copper Drainage Tube (DWV)
- DD. ASTM C14 - Concrete Sewer, Storm Drain, and Culvert Pipe
- EE. ASTM C425 - Compression Joints for Vitrified Clay Pipe and Fittings
- FF. ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
- GG. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings
- HH. ASTM C700 - Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
- II. ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- JJ. ASTM D2235 - Solvent Cement for Acrylonitrile - Butadiene - Styrene (ABS) Plastic Pipe and Fittings
- KK. ASTM D2241 - Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)

- LL. ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
- MM. ASTM D2513 - Thermoplastic Gas Pressure Pipe, Tubing and Fittings
- NN. ASTM D2564 - Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
- OO. ASTM D2680 - Acrylonitrile-Butadiene-Styrene (ABS) Composite-Sewer Piping
- PP. ASTM D2683 - Socket-Type Polyethylene Fillings for Outside Diameter - Controlled Polyethylene Pipe
- QQ. ASTM D2729 - Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
- RR. ASTM D2751 - Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
- SS. ASTM D2846 - Chlorinated Polyvinyl Chloride (CPVC) Pipe, Fittings, Solvent Cements and Adhesives for Potable Hot Water Systems
- TT. ASTM D2855 - Making Solvent-Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings
- UU. ASTM D3033 - Type PSP Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings
- VV. ASTM D3034 - Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings
- WW. ASTM D3309 - Polybutylene (PB) Plastic Hot Water Distribution System
- XX. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- YY. ASTM F493 - Solvent Cements for Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe and Fittings
- ZZ. ASTM F845 - Plastic Insert Fittings for Polybutylene (PB) Pipe
- AAA. AWS A5.8 - Brazing Filler Metal. BA. AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids
- BBB. AWWA C110 - Ductile - Iron and Gray - Iron Fittings 3 in. through 48 in., for Water and Other Liquids
- CCC. AWWA C111 - Rubber-Gasket Joints for Ductile Iron and Gray-Iron Pressure Pipe and Fittings
- DDD. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
- EEE. AWWA C651 - Disinfecting Water Mains
- FFF. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems
- GGG. CISPI 310 - Joints for Hubless Cast Iron Sanitary Systems

HHH.CAN-3 B281 - Aluminum Drain, Waste, and Vent Pipe and Components

III. NCPWB - Procedure Specifications for Pipe Welding

JJJ. NFPA 54 - National Fuel Gas Code

KKK.NFPA 58 - Storage and Handling of Liquefied Petroleum Gases

LLL.TDH - Texas Department of Health, Water System Regulations

#### **1.04 SUBMITTALS**

- A. Submit under provisions of Section 23 00 00.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

#### **1.05 PROJECT RECORD DOCUMENTS**

- A. Submit under provisions of Section 23 00 00.
- B. Record actual locations of valves, etc. and prepare valve charts.

#### **1.06 OPERATION AND MAINTENANCE DATA**

- A. Submit under provisions of Section 23 00 00.
- B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

#### **1.07 QUALITY ASSURANCE**

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
- C. Welder's Certification: In accordance with ASME Sec. 9. Submit welder's certifications prior to any shop or field fabrication. Welder's certifications shall be current within six months of submission.
- D. Maintain one copy of each document on site.

#### **1.08 QUALIFICATIONS**

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years' documented experience.
- B. Installer: Company specializing in performing the work of this section with minimum of three years' documented experience.

#### **1.09 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, protect and handle products to site under provisions of Section 23 00 00.



- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

## **PART 2 PRODUCTS**

### **2.01 STEEL PIPING:**

- A. Scope: This section applies to all piping systems providing for welded piping, fittings, and other appurtenances. Specific systems requiring welded piping include, but are not limited to: chilled water, hot water, steam, steam condensate, and fire protection systems.
- B. Pipe: Unless otherwise indicated, chiller and boiler plants piping shall be Schedule 40, and underground and building piping shall be Standard weight, Grade A or B, seamless black steel pipe conforming in all details to Standard ASTM Designation A135, A106, and A53, latest revisions. Steam condensate shall be Schedule 80.
- C. Fittings:
  - 1. All weld fittings shall be domestic made wrought carbon steel butt-welding fittings conforming to ASTM A234 and ASME/ANSI B16.9, latest edition, as made by Weld Bend, Tube Turn, Hackney, or Ladish Company. Attach to only pipe with a hole for the entire length. Each fitting shall be stamped as specified by ASME/ANSI B16.9 and, in addition, shall have the laboratory control number metal stenciled on each fitting for ready reference as to physical properties required for any fittings selected at random. Fittings which have been machined, remarked, printed, or otherwise produced domestically from non-domestic forgings or materials will not be acceptable. Each fitting is to be marked in accordance with MSS SP-25. Markings shall be placed on the fittings at the farthest point from the edge to be welded to prevent disfiguring from the welding process. Submittal data for these fittings shall include a letter signed by an official of the manufacturing firm certifying compliance with these specifications.
  - 2. All screwed pattern fittings specifically called for shall be Class 150 malleable iron fittings of Grinnell Company, Crane Company or Walworth Company manufacture (300 lb. for unions).
- D. FABRICATION:
  - 1. Welded piping and fittings in chiller and boiler plants shall be fabricated in accordance with ASME/ANSI the latest editions of Standards B31.1 and B31.3 for Steam and Condensate systems, from the Code for Pressure Piping. Standard B31.9 –Building Services Piping may be used within buildings. Machine beveling in shop is preferred. Field beveling may be done by flame cutting to recognized standards.

2. Ensure complete penetration of deposited metal with base metal. Contractor shall provide filler metal suitable for use with base metal. Contractor shall keep inside of fittings free from globules of weld metal. All welded pipe joints shall be made by the fusion welding process, employing a metallic arc or gas welding process. All pipe shall have the ends beveled 37-1/2 degrees and all joints shall be aligned true before welding. Except as specified otherwise, all changes in direction, intersection of lines, reduction in pipe size and the like shall be made with factory-fabricated welding fittings. Mitering of pipe to form elbows, notching of straight runs to form tees, or any similar construction will not be permitted.
3. Align piping and equipment so that no part is offset more than 1/16 inch. Set all fittings and joints square and true, and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.
4. Do not permit any weld to project within the pipe so as to restrict it. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.
5. Do not split, bend, flatten or otherwise damage piping before, during or after installation.
6. Remove dirt, scale and other foreign matter from the inside of piping, by swabbing or flushing, prior to the connection of other piping sections, fittings, valves or equipment.
7. In no cases shall Schedule 40 pipe be welded with less than three passes including one stringer/root, one filler and one lacer. Schedule 80 pipe shall be welded with not less than four passes including one stringer/root, two filler and one lacer. In all cases, however, the weld must be filled before the cap weld is added.
8. Procedure of Assembling Screw Pipe Fittings: All screw joints shall be made with taper threads properly cut. Joints shall be made tight with Teflon applied to the pipe threads only and not to fittings. When threads are cut on pipes, the ends shall be carefully reamed to remove any burrs. Before installing pipe that has been cut and threaded, the lengths of pipe shall be upended and hammered to remove all shavings and foreign material.

E. WELD TESTING:

1. All welds are subject to inspection, visual and/or X-ray, for compliance with specifications. The owner will, at the owner's option, provide employees or employ a testing laboratory for the purposes of performing said inspections and/or X-ray testing. Initial visual and X-ray inspections will be provided by the owner. The contractor shall be responsible for all labor, material and travel expenses involved in the re-inspection and re-testing of any welds found to be unacceptable. In addition, the contractor shall be responsible for the costs involved in any and all additional testing required or recommended by ASME/ANSI Standards B31.1, B31.9, and B31.3 due to the discovery of poor, unacceptable, or rejected welds.
2. Welds lacking penetration, containing excessive porosity or cracks, or are found to be unacceptable for any reason, must be removed and replaced with an original quality weld as specified herein. All qualifying tests, welding and stress

relieving procedures shall, moreover, be in accord with Standard Qualification for Welding Procedures, Welders and Welding Operators, Appendix A, Section 6 of the Code, current edition.

## **2.02 CAST IRON PIPING:**

### **A. PIPE & FITTINGS:**

1. Service weight cast iron soil pipe conforming to ASTM Specification A-74 and CISPI Standard 301, hub and spigot for pipe ten inch (10") and larger and hubless for eight inch (8") and smaller. Each piece of pipe and each fitting shall be coated at the factory with asphaltum or coal tar pitch and with the manufacturer's mark or name cast on it.
2. All joints in hub and spigot cast iron pipe shall be made water and gas tight with Tyseal neoprene gaskets. Lead and Oakum may be used only under special conditions, with prior written permission from the Resident Construction Manager. Joints in hubless cast iron soil pipe and fittings shall be made by the use of a neoprene sleeve and 24-gauge, Type 304 Stainless Steel shield made tight with a torque wrench and torqued to a minimum of 100 inch-pounds. Each clamp shall consist of a neoprene gasket with a stainless steel outer band which effectively captures the gasket material. Each clamp shall bear the FM and UPC stamp, shall be approved to Class I of Factory Mutual Standard #1680, and shall be Clamp-All or approved equal. All elbows and tees shall be braced against thrust loads which might result in joint separation due to static pressure or dynamic forces caused by sudden, heavy impulse loading (water hammer) conditions. Hubless piping systems shall not be used in a directly buried, underground application.

## **2.03 GALVANIZED STEEL PIPE**

- A. Pipe: Schedule 40 and shall conform in every detail to ASTM Standard Specifications for BLACK AND HOT-DIPPED ZINC-COATED GALVANIZED WELDED AND SEAMLESS STEEL PIPE ASTM Designation A-135, latest revision. This threaded pipe shall be supplied with thread protectors on each end. All steel water pipe shall be hot-dipped galvanized pipe zinc coated both inside and outside.
- B. Fittings: All fittings for six inch (6") and larger water lines shall be 125 lb., cast iron, flanged pattern fittings. These fittings shall be hot-dipped galvanized, after all machining operations have been completed. These fittings shall be of Crane Company, or approved equal, manufacture and their flanges shall be dimensioned, faced drilled and spot faced to conform to the Class 150 American Standard for Steel Pipe Flanges and Flanged Fittings.

## **2.04 COPPER PIPE**

- A. Copper Pipe: Piping four inches (4") and smaller shall be fabricated of Type K, hard drawn, copper pipe made of deoxidized copper (99.9% pure). This Type K copper pipe shall conform in every detail to ASTM Standard Specifications for COPPER WATER TUBE, Serial Designation B-88-66, and it shall be provided in 20-foot straight lengths. Copper pipe 4" and smaller may only be joined using non-lead-bearing solder, such as 95-5 silver or antimony solder (95 percent tin, and 5 percent silver or antimony). Copper pipe 4" and larger may be joined using roll grooved fittings.

(Note: For UT Austin, substitute the following sentence for the previous two sentences: "Copper pipe may only be joined using "Silvabrite" solder. No other solders may be used.")

- B. Fittings: All fittings for four inch (4") and smaller water lines shall be Streamline Solder Fittings manufactured by Streamline Pipe and Fittings Division, Mueller Brass Company, or approved equal. These wrought copper fittings shall be rigid and strong with openings machined to accurate capillary fit for the pipe.
- C. Lead: It is forbidden that lead in any form be used in any water system other than waste. If lead is used in the fabrication or installation of any water system other than waste, then ALL of the installed equipment and material, which may have come in contact with the lead, shall be marked with bright red or orange spray paint, and shall be removed from the project site. The system(s) shall then be restored and reinstalled using ALL NEW MATERIALS.

## 2.05 VALVES:

- A. All valves shall be located such that the removal of their bonnets is possible. All flanged valves shown in horizontal lines with the valve stem in a horizontal position shall be positioned so that the valve stem is inclined one bolt hole above the horizontal position. Screw pattern valves placed in horizontal lines shall be installed with their valve stems inclined at an angle of a minimum of 30 degrees above the horizontal position. All valves must be true and straight at the time the system is tested and inspected for final acceptance. Valves shall be installed as nearly as possible to the locations indicated in the Construction Drawings. Any change in valve location must be so indicated on the Record Drawings. All valves must be of threaded or flanged type. No solder connected or grooved fitting valves shall be used on this project. All bronze and iron body gate and globe valves shall be the product of one manufacture for each project. Manufacturers of other types may not be mixed on the same project; i.e., all butterfly valves shall be of the same manufacture, all ball valves shall be of the same manufacture, etc.
- B. All valves used in circulating systems, plumbing and steam systems (low and medium pressure) shall be Class 150 SWP. Class 300 valves shall be constructed of all ASTM B-61 composition. All gate, globe and angle valves shall be union bonnet design. Metal used in the stems of all bronze gate, globe and angle valves shall conform to ASTM B371 Alloy 694, ASTM B99 Alloy 651, or other corrosion resistant equivalents. Written approvals must be secured for the use of alternative materials. Alloys used in all bronze ball, gate, globe, check, or angle valves shall contain no more than 15% zinc. No yellow brass valves will be allowed.
- C. All iron body valves shall have the pressure containing parts constructed of ASTM designated of 126 class B iron. Stem material shall meet ASTM B16 Alloy 360 or ASTM 371 Alloy 876 silicon bronze or its equivalent. Gates and globes shall be bolted bonnet with OS&Y (outside screw and yoke) and rising stem design. A lubrication fitting is preferred on yoke cap for maintenance lubrication of the yoke bushing.
- D. All cast steel body valves shall have the pressure containing parts constructed of ASTM designation A-216-GR-WCB carbon steel. Gate and globe valves shall be bolted bonnet outside and screw and yoke design with pressure-temperature rating conforming to ANSI B16-34-1977. Stems shall meet ASTM designation A-186-F6 chromium stainless steel. Wedge (gate valves) may be solid or flexible type and shall meet ASTM A-182-F6 chromium stainless steel on valves from 2" to 6". Sizes 8" and larger may be A-216-WCB with forged rings or overlay equal to 182-F6. Seat ring shall be hard faced carbon steel or 13% chromium A-182-F6 stainless. Handwheels shall be A47 Grade 35018 malleable iron or Ductile Iron ASTM A536.
- E. All forged steel body valves shall have the pressure containing parts constructed of ASTM 105, Grade 2 forged carbon steel. Seat and wedges shall meet ASTM A-182-F6 chromium stainless steel. Seat rings shall be hard faced. Valves shall conform to ANSI B16-34 pressure-temperature rating.

- F. All valves shall be repackable, under pressure, with the valve in the full open position. All gate valves, globe valves, angle valves and shutoff valves of every character shall have malleable iron hand wheels, except iron body valves 2-1/2" and larger which may have either malleable iron or ASTM A-126 Class B, gray iron hand wheels.
- G. Packing for all valves shall be free of asbestos fibers and selected for the pressure-temperature service of the valve. It is incumbent upon the manufacturer to select the best quality, standard packing for the intended valve service. At the end of one year, period spot checks will be made, and should the packing show signs of hardening or causing stem corrosion then all valves supplied by the manufacturer shall be repacked by the Contractor, at no expense to the Owner, with a packing material selected by the Owner.
- H. Valves 12" and larger located with stem in horizontal position shall be drilled and tapped in accordance with MSS-SP-45 to accommodate a drain valve and equalizing by-pass valve assembly.
- I. Balancing and/or Shutoff Valves for Hot Water Systems: Two inches and smaller, three piece full port bronze body ball valve, stainless steel ball and stem. Teflon seats, packing and gasket, bronze gland follower, adjustable stuffing box, steel lever type handle, with plastic sheathed operating handle, adjustable memory stops, and shall be class 150 SWP/600 WOG, screwed pattern. Manufacturer shall certify ball valves for use in throttling service. Stem extensions shall be furnished for use in insulated lines. Cold water service valves shall be as above, except two piece construction. All valves 2 1/2" and larger shall be tapped full lug butterfly valves with aluminum bronze discs of ASTM B148 Alloy C955 and 316, 416, or 420 stainless steel shafts. Design must incorporate bushing between shafts and body of material suitable to provide a bearing surface to eliminate seizing or galling. Valve must be capable of providing a bubble tight seal at 200 psi for valves up to 12" (150 psi for larger valves) when used for end of line service without requiring the installation of a blind flange on the downstream side. Liners shall be resilient material suitable for 225 °F temperature and bodies of ductile iron. Butterfly valves 8" and larger and butterfly valves used for balancing service, regardless of size, shall have heavy duty weather proof encased gear operators, with malleable iron handwheel or crank. Valves 2 1/2" through 6" shall have lever handles which can be set in interim positions between full open and full closed. All butterfly valves shall be absolutely tight against a pressure differential of 150 psi.
- J. Check Valves for Water Systems: Bronze body, 2" and smaller, bronze body regrinding disc and seat with screw-in cap. Iron body, 2 1/2" and larger, bronze disc and seat or non slam wafer type with stainless pins and springs, and bronze plate. Forged steel lift check valves, 2" and smaller shall be bolted cap and body, screwed end connections and conform to ANSI B16.34 and pressure temperature rating.
- K. Valves for Fire Protection Service: 2" and smaller, bronze body ball valve as above, Underwriters' Laboratories Listed and Factory Mutual Approved, screw pattern 2 1/2" and larger, Underwriters Laboratories Listed and Factory Mutual Approved butterfly valves with tapped full lug body and gear operated with malleable iron hand-wheel and position indicator. All valves to be furnished with two factory mounted internal supervisory switches.  
  
Gate valves 2 1/2" and larger shall have approved rating of 175 psi WWP or greater, iron body with resilient rubber encapsulated wedge, epoxy-coated interior, and pre-grooved stem for supervisory switch.
- L. Check Valves Fire Protection System: Iron body, swing-check, bronze disc, seat ring and hinge pin, 300 psi rated working pressure, Underwriters' Laboratories and Factory Mutual approved. Complete with ball drip assembly.

M. Standards of Quality for Valves:

Standard of Quality for Valves:

				<u>Class</u>	<u>Milwaukee</u>	<u>Nibco</u>	<u>Stockham or as noted</u>
*2" & smaller	Ball Valve "	Chilled Water	1	50 --		T-585-70	Apollo 77-100
Requires extended stems in insulated lines with adjustable memory stop.							
*2" & Smaller	Ball Valve	Domestic Hot & Cold Water Plumbing Systems		150	--	Nibco T-585-Y-66	Apollo 77-140
Requires extended stems in insulated lines with adjustable memory stop.							
2" & smaller	Check Valve	All Water Systems		150	510	T-433	B-345
2-1/2" & larger	Check Valve	All Water Systems		150	1400 Series	W-920-W	Stockham 'Duo-Check'

**2.13 UNIONS:**

- A. Provide and install unions at proper points to permit removal of pipe and various equipment and machinery items without injury to other parts of the system. No unions will be required in welded lines or lines assembled with solder joint fittings except at equipment items, machinery items and other special pieces of apparatus. Unions in 2" and smaller in ferrous lines shall be Class 300 AAR malleable iron unions with iron to brass seats, and 2 1/2" and larger shall be ground flange unions. Unions in copper lines shall be Class 125 ground joint brass unions or Class 150 brass flanges if required by the mating item of equipment. Companion flanges on lines at various items of equipment, machines and pieces of apparatus shall serve as unions to permit removal of the particular items. See particular Specifications for special fittings and pressure.
- B. Unions connecting ferrous pipe to copper or brass pipe shall be dielectric type equal to EpcO.
- C. In all water lines where the material of the pipe is changed from ferrous to copper or brass, a dielectric coupling shall be used at the transition.

**2.14 FLANGES:**

- A. All 150 lb. and 300 lb. ANSI flanges shall be weld neck and shall be domestically manufactured, forged carbon steel, conforming to ANSI B16.5 and ASTM A-181 Grade I or II or A-105-71 as made by Tube Turn, Hackney or Ladish Company. Slip on flanges shall not be used. Each fitting shall be stamped as specified by ANSI B16.9 and, in addition, shall have the laboratory control number stenciled on each fitting for ready reference as to physical properties and chemical composition of the material. Complete test reports may be required for any fitting selected at random. Flanges which have been machined, remarked, painted or otherwise produced domestically from imported forges will not be acceptable. Flanges shall have the manufacturer's

trademark permanently identified in accordance with MSS SP-25. Contractor shall submit data for firm certifying compliance with these Specifications. Bolts used shall be carbon steel bolts with semi-finished hexagon nuts of American Standard Heavy dimensions. Allthread rods will not be an acceptable for flange bolts. Steam system flange bolts shall have a tensile strength of 105,000 psi and an elastic limit of 81,000 psi and rated at least ANSI Grade V. Other bolts shall have a tensile strength of 80,000 psi and an elastic limit of 36,000 psi and rated at least ANSI Grade I.

- B. Flat faced flanges shall be furnished to match 125 lb cast iron flanges on pumps, check valves, strainers, etc. with full flange gaskets. Bolting of raised face flanges to flat faced flanges is not allowed.

C. FLANGE GASKETS

1. Gaskets shall be placed between the flanges of all flanged joints.
2. Gaskets for steam piping - All steam flange joints shall use Flexitallic Class 150 spiral wound for low pressure applications and Flexitallic Class 300 spiral wound gaskets for medium or high pressure applications. Raised and flat face flange gaskets shall be Flexitallic compression gauge (CG) style. External ring shall be Type 304 stainless steel and color coded yellow. Filler material shall be Flexite Super and color coded with pink stripe. Equivalentents may be submitted with all design data so that an evaluation of the gasket can be made.
3. Gaskets for all other applications: Gaskets shall be ring form gaskets fitting within the bolt circle of their respective flanges. Gaskets shall be 1/16" thick asbestos free material recommended for service by Anchor, Garlock, or John Crane. The inside diameter of such gaskets shall conform to the nominal pipe size and the outside diameter shall be such that the gasket extends outward to the studs or bolts employed in the flanged joint.
4. Spares - Contractor shall provide ten spares for every flange size and rating.

D. Flange Bolt Installation:

1. Bolt Lubrication: Bolts shall be well lubricated with a heavy graphite and oil mixture.
2. Torque Requirements - Bolts shall be stressed to 45,000 psi.

Nominal Bolt Dia. (Inch)	Torque (Ft-Lbs)
.25	6
.3125	12
.375	18
.4375	30
.5	45
.5625	68
.625	90
.75	150
.875	240
1.0	368
1.125	533
1.25	750
1.375	1020
1.5	1200

3. Torque shall be checked with a calibrated breaking action torque wrench on the final torque round. Bolts shall be cold and hot torqued.
4. Torque Pattern - Shall be a cross or star pattern with at least four passes. Limit each pass to 30% of full torque increases.
5. Hot Torque - Re-torque the flange bolts with system at normal operating pressure and temperature for at least four hours.
6. Inspection - Owner shall verify hot torquing of all medium and high pressure steam flange bolts.

**PART 3 EXECUTION**

Refer to other Sections for service specific requirements.

**3.01 EXAMINATION**

- A. Verify excavations under provisions of Section 23 00 00.
- B. Verify that excavations are to required grade, dry, and not over-excavated.

**3.02 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.



### **3.03 INSTALLATION**

- A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- B. Route piping in orderly manner and maintain gradient.
- C. Install piping to conserve building space and not interfere with use of space.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Provide clearance for installation of insulation and access to valves and fittings.
- G. Provide access where valves and fittings are not exposed. Coordinate access door location with architectural features.
- HI. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- I. Provide support for utility meters in accordance with requirements of utility companies.
- J. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting. Refer to Division 09.
- K. Install valves with stems upright or horizontal, not inverted.

### **3.04 ERECTION TOLERANCES**

- A. Establish invert elevations, slopes for drainage to 1/8 inch per foot (one percent) minimum. Maintain gradients through each joint of pipe and throughout system.
- B. Slope water piping and arrange to drain at low points.

### **END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

This Page is Intentionally Blank

## **SECTION 23 21 00**

### **HYDRONIC PIPING**

#### **PART 1 GENERAL**

##### **1.00 The following sections are to be included as if written herein:**

- A. Section 23 00 00 – Basic Mechanical Requirements
- B. Section 23 05 29 – Sleeves, Flashings, Supports and Anchors
- C. Section 23 05 53 – Mechanical Identification

##### **1.01 WORK INCLUDED**

- A. Pipe and Pipe Fittings
- B. Valves
- C. Chilled Water Piping System

1.02 SCOPE OF WORK: Furnish and install all labor, materials, equipment, tools and services and perform all operations required in connection with, or properly incidental to, the construction of complete HVAC piping and accessories systems as indicated on the Drawings, reasonably implied therefrom, or as specified herein unless specifically excluded.

##### **1.03 RELATED WORK**

- C. Section 23 20 00.A - Piping, Valves and Fittings
- E. Section 21 05 48 - Vibration Isolation
- G. Section 23 07 19 - Piping Insulation

##### **1.04 REFERENCES**

- A. ANSI/ASME - Boiler and Pressure Vessel Code
- B. ANSI/ASME Sec 9 - Welding and Brazing Qualifications
- C. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings Class 150 and 300
- D. ANSI/ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV
- E. ANSI/ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV

- F. ANSI/ASME B31.9 - Building Services Piping
- G. ANSI/ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
- H. ANSI/AWS A5.8 - Brazing Filler Metal
- I. ANSI/AWS D1.1 - Structural Welding Code
- J. ANSI/AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids
- K. ANSI/AWWA C110 - Ductile - Iron and Gray - Iron Fittings 3 in. through 48 in., for Water and Other Liquids
- L. ANSI/AWWA C111 - Rubber-Gasket Joints for Ductile Iron and Gray-Iron Pressure Pipe and Fittings
- M. ANSI/AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
- N. ASTM A135 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless
- O. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
- P. ASTM B32 - Solder Metal
- Q. ASTM B88 - Seamless Copper Water Tube
- R. ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- S. ASTM D2235 - Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
- T. ASTM D2241 - Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
- U. ASTM D2310 - Machine-Made Reinforced Thermosetting Resin Pipe
- V. ASTM D2466 - Socket-Type PVC Plastic Type Fittings, Schedule 40
- W. ASTM D2467 - Socket-Type PVC Plastic Type Fittings, Schedule 80
- X. ASTM D2680 - Acrylonitrile-Butadiene-Styrene (ABS) Composite-Sewer Piping
- Y. ASTM D2683 - Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing

Z. ASTM D2751 - Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings

AA. ASTM D2855 - Making Solvent-Cemented Joints with PVC Pipe and Fittings

BB. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe

#### **1.05 REGULATORY REQUIREMENTS**

A. Conform to ANSI/ASME B31.9

#### **1.06 QUALITY ASSURANCE**

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. Welding Materials and Procedures: Conform to ANSI/ASME SEC. 9, and applicable state labor regulations.

C. Welders Certification: In accordance with ANSI/AWS D1.1.

#### **1.07 SUBMITTALS**

A. Submit product data under provisions of Section 23 00 00.

B. Include data on pipe materials, pipe fittings, valves, and accessories.

C. Include welder's certification of compliance with ANSI/AWS D1.1.

#### **1.08 DELIVERY, STORAGE, AND HANDLING**

A. Deliver products to site under provisions of Section 23 00 00.

B. Store and protect products under provisions of Section 23 00 00.

C. Deliver and store valves in shipping containers with labeling in place.

### **PART 2 PRODUCTS**

#### **2.01 WALL, FLOOR AND CEILING PLATES:**

A. See Section 23 05 29.

#### **2.02 SLEEVES, INSERTS, AND FASTENINGS:**

A. See Section 23 05 29.

#### **2.05 CHILLED WATER PIPING - ABOVE GROUND:**

A. See Section 23 20 00.A and 23 06 20.13.

1. Building chilled water piping shall be hard drawn Type K copper with wrought copper sweat fittings and dielectric unions where connected to dissimilar materials.
2. EM chilled water piping shall be hard drawn Type K copper with wrought copper sweat fittings
3. Low Zone (0' to 150' elevation)
  - a. Fittings on piping 2-1/2" and larger shall be standard weight butt welding type. Flanges shall be 150# welding neck type. Standard weight Weld-O-Lets, Thread-O-Lets, and shaped nipples may be used only when take-off is 1/3 or less nominal size of main. Bushings shall not be used.
  - b. Fittings on piping 2" and smaller shall be Class 150 black malleable iron screw fittings. (Class 300 for unions.)
  - c. Valves and strainers: Class 150.

## **2.08 EQUIPMENT DRAIN PIPING:**

- A. All factory fabricated or field erected air conditioning units with drain pans, all centrifugal water pumps and all other items or equipment or apparatus that require drains shall be connected with drain line run with adequate slope to a floor drain or other point of discharge as shown on the Drawings. On A.C. units the drain line shall include a properly sized water-sealed trap.
- B. All drain piping shall be one inch (1") size minimum or larger as may be indicated on the Drawings. Such piping shall be Type L hard copper tube. The drain piping shall be assembled with adapter tees at each change in direction. Install screw plugs in unused openings for access to rod and clean.

## **PART 3 EXECUTION**

### **3.01 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.
- D. After completion, fill, clean, and treat systems. Refer to Section 22 13 16.UT

### **3.02 INSTALLATION**

- A. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient.

- B. Install piping to conserve building space, and not interfere with use of space and other work.
- C. Group piping whenever practical at common elevations.
- D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 05 16.
- E. Provide clearance for installation of insulation, and access to valves and fittings.
- F. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- G. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to weld area.
- H. Prepare pipe, fittings, supports, and accessories for finish painting. Refer to Section 09 91 00.
- I. Install valves with stems upright or horizontal, not inverted.

### **3.03 FABRICATION OF PIPE:**

- A. All the various piping systems shall be made up straight and true and run at proper grades to permit proper flow of the contained material. Lines shall also be graded for proper drainage.
- B. Piping shall follow as closely as possible the routes shown on Drawings which take into consideration conditions to be met at the site.
- C. Should any unforeseen conditions arise, lines shall be changed or rerouted as required after proper approval has been obtained.
- D. All piping shall be installed with due regard to expansion and contraction and so as to prevent excessive strain and stress in the piping, in connections, and in equipment to which the lines are connected.
- E. All piping shall be clean when it is installed. Before installation it shall be checked, upended, swabbed, if necessary, and all rust or dirt from storage or from lying on the ground shall be removed.
- F. Procedure of Assembling Screw Pipe Fittings: All screw joints shall be made with taper threads, properly cut. Joints shall be made tight with Teflon applied to the pipe threads only and not to fittings. When threads are cut on pipes, the ends shall be carefully reamed to remove any burrs. Before installing pipe that has been cut and threaded, the lengths of pipe shall be upended and hammered to remove all shavings and foreign material.

G. Procedure for Assembling Other Joints: Procedures for assembling joints in cast iron and copper lines have been set forth elsewhere in these Specifications. For any special materials, consult the manufacturers for the recommended procedures in assembling the joints.

### **3.04 APPLICATION**

A. Grooved mechanical couplings and fasteners may be used only in accessible locations and for pump fit-up assemblies, when approved by Owner in writing.

B. Install unions downstream of valves and at equipment or apparatus connections.

C. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.

D. Install [ball] [butterfly] valves for shut-off and to isolate equipment, part of systems, or vertical risers.

E. Install [ball] [butterfly] valves for throttling, bypass, or manual flow control services.

F. Provide spring loaded check valves on discharge of condenser water pumps.

G. Use gas plug cocks for throttling service. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.

H. Use butterfly valves [in heating water systems] [in chilled and condenser water systems] [in heating, chilled and condenser water systems].

I. Use only butterfly valves in chilled and condenser water systems for throttling and isolation service.

J. Use lug end butterfly valves to isolate equipment.

K. Provide 3/4 inch (20 mm) ball drain valves at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. [Pipe to nearest drain.]

### **3.05 PIPE PRESSURE TESTS:**

A. See Section 23 00 00.

### **3.06 CLEANING AND FLUSHING OF WATER SYSTEMS**

A. Water circulating Systems shall be thoroughly cleaned before placing in operation to rid systems of rust, dirt, piping compound, mill scale, oil, grease, any and all other material foreign to water being circulated.

B. Extreme care shall be exercised during construction to prevent dirt and other foreign matter from entering the pipe or other parts of systems. Pipe stored on the project shall have open



ends capped and equipment shall have openings fully protected. Before erection, each piece of pipe, fitting, or valve shall be visually examined and dirt removed.

- C. At pipe end locations a temporary bypass will be installed. Bypass shall be *same* size as the supply and return pipe. Prior to flushing the distribution system, the Contractor shall install the temporary bypass and a temporary line size strainer between the supply and return pipes. Contractor shall verify that the isolation valves are open.

**END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

This Page is Intentionally Blank

## SECTION 23 31 00

### DUCTWORK

#### PART 1 GENERAL

##### 1.00 The following sections are to be included as if written herein:

- A. Section 23 00 00 – Basic Mechanical Requirements
- B. Section 23 05 29 – Sleeves, Flashings, Supports and Anchors
- C. Section 23 05 53 – Mechanical Identification

##### 1.01 WORK INCLUDED

- A. Low Pressure Ducts
- B. Medium and High Pressure Ductwork
- C. Duct Cleaning

##### 1.02 RELATED WORK

- A. Section 23 05 48 - Vibration Isolation
- B. Section 23 07 13 - Duct Insulation
- C. Section 23 33 00 - Ductwork Accessories
- D. Section 23 36 00 - Air Terminal Units
- E. Section 23 05 93.A - Testing, Adjusting and Balancing

##### 1.03 REFERENCES

- A. ASHRAE - Handbook of Fundamentals; Duct Design
- B. ASHRAE - Handbook of Equipment; Duct Construction
- C. ASTM A 90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles
- D. ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- E. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
- F. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality
- G. ASTM B209 - Aluminum and Aluminum Alloy Sheet and Plate
- H. ASTM C 14 - Concrete Sewer, Storm Drain, and Culvert Pipe

- I. ASTM C 443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
- J. NFPA 90A - Installation of Air Conditioning and Ventilating Systems
- K. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems
- L. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooling Equipment
- M. SMACNA - Low Pressure Duct Construction Standards
- N. SMACNA - High Pressure Duct Construction Standards
- O. UL 181 - Factory-Made Air Ducts and Connectors

#### **1.04 REFERENCES**

- A. Fundamentals Handbook, American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).
- B. Equipment Handbook, ASHRAE.
- C. HVAC Duct Construction Standards, Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
- D. HVAC Duct System Design, SMACNA.
- E. Round Industrial Duct Construction Standards, SMACNA.
- F. Engineering Design Manual for Air Handling Systems, United McGill Corporation (UMC).
- G. Assembly and Installation of Spiral Duct and Fittings, UMC.
- H. Engineering Report No. 132 (Spacing of Duct Hangers), UMC.

#### **1.05 DEFINITIONS**

- A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.
- B. Low Pressure: 2 inch WG positive or negative static pressure and velocities less than 1,500 fpm.
- C. Medium Pressure: 6 inch WG positive static pressure and velocities greater than 1,500 fpm.
- D. High Pressure: 10 inch WG positive static pressure and velocities greater than 2,500 fpm.

## **1.06 REGULATORY REQUIREMENTS**

- A. Construct ductwork to NFPA 90A, NFPA 90B and NFPA 96 standards.

## **1.07 SUBMITTALS**

- A. Shop Drawings shall be submitted on all items of sheet metal work specified herein. Shop Drawings of ductwork at air units shall be submitted at a minimum scale of 3/8" equal to one foot.
- B. Shop Drawings shall be submitted on all other ductwork per Section 23 00 00. Shop Drawings shall indicate location of all supply, return, exhaust and light fixtures from the approved reflected ceiling plans.
- C. Submit shop drawings and product data under provisions of Section 23 00 00.
- D. Submit samples under provisions of Section 23 00 00.

## **1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to site under provisions of Section 23 00 00.
- B. Store and protect products under provisions of Section 23 00 00.

## **PART 2 PRODUCTS**

### **2.01 DUCTWORK GENERAL:**

- A. All ductwork indicated on the Drawings, specified or required for the air conditioning and ventilating systems shall be of materials as hereinafter specified unless indicated otherwise. All air distribution ductwork shall be fabricated, erected, supported, etc., in accordance with all applicable standards of SMACNA Duct Manuals where such standards do not conflict with NFPA 90A and where class of construction equals or exceeds that noted herein. All exhaust ductwork including toilet room exhausts shall be constructed and leak tested as specified for medium pressure supply ducts at negative pressure.
- B. All ductwork shown on the Drawings, specified or required for the heating, ventilating and air conditioning systems shall be constructed and erected in a first class workmanlike manner. The work shall be guaranteed for a period of one (1) year from and after the date of acceptance of the job against noise, chatter, whistling, vibration, and free from pulsation under all conditions of operation. After the system is in operation, should these defects occur, they shall be corrected as directed by the Architect.
- C. All duct sizes shown on the Drawings are air stream sizes. Allowance shall be made for internal lining where required, to provide the required cross sectional area.
- D. All holes in ducts for damper rods and other necessary devices shall be either drilled or machine punched (not pin punched), and shall not be any larger than necessary. All duct openings shall be provided with sheet metal caps if the openings are to be left unconnected for any length of time.
- E. Except for special ducts specified elsewhere herein, all sheet metal used on the project shall be constructed from prime galvanized steel sheets and/or coils up to 60" in width. Each sheet shall be stenciled with manufacturer's name and gauge. Coils of sheet steel shall be

stenciled throughout on ten foot (10') centers with manufacturer's name and must be visible after duct is installed. Sheet metal must conform to SMACNA sheet metal tolerances as outlined in SMACNA's "HVAC Duct Construction Standards."

- F. Where ducts that are exposed to view (including equipment rooms), pass through walls, floors or ceilings, furnish and install sheet metal collars around the duct.

## **2.02 DUCTWORK LOW PRESSURE: (Includes all exhaust ductwork downstream of fans.)**

- A. The scope of low pressure ductwork is defined as all ductwork downstream of terminal units, and all exhaust ductwork downstream of fans. Construction of all low pressure duct shall be in accordance with Low Velocity Duct Construction Standards as published by Sheet Metal and Air Conditioning Contractors National Association (SMACNA) and shall be sealed and tested at 3" static with the same test procedures as medium pressure ductwork.
- B. Spiral wound round duct shall be as manufactured by United McGill Sheet Metal Company or approved equal.
- C. The metal gauges listed in the 1985 SMACNA HVAC Duct Construction Standards for Metal and Flexible Duct are the minimum which shall be used for this project. It shall be noted that the Contractor is responsible that the metal gauge selected is heavy enough to withstand the physical abuse of the installation.
- D. Elbows shall be radius type and have a centerline radius of 1-1/2 times the duct diameter or width. Elbows in round ducts may be smooth radius as described above or 5-piece 90 degree elbows and 3-piece 45 degree elbows. Joints in round ducts shall be slip type with a minimum of three sheet metal screws. Joints in sectional elbows shall be sealed as specified for duct sealing.
- E. SEALANT: All ductwork (except welded exhaust duct) shall be sealed with either "MP" (Multi-Purpose), Hardcast "Iron-grip 601", Polymer Adhesive "Airseal #11", or "United Duct Seal" (United McGill Corp.) water base, latex or acrylic type sealant. Note that, except as noted, oil or solvent based sealants are specifically prohibited for use on this project. For exterior applications, "Uni-Weather" (United McGill Corp.) neoprene based sealant shall be used. No other sealants may be used. All seams and joints in shop and field fabricated ductwork shall be sealed by applying one layer of sealant, then immediately spanning the joint with a single layer of 3" wide open weave fiberglass tape. Sufficient additional sealant shall then be applied to completely imbed the cloth. All sealants shall be UL rated at no more than flame spread of 5 and smoke developed of 0. At contractor's option Hardcast 1602 sealant tape may be used in lap joints and flat seams.

## **2.03 DUCTWORK MEDIUM PRESSURE: (Includes all exhaust ductwork upstream of fans).**

- A. The scope of medium pressure ductwork is defined as all ductwork downstream of all air handlers, up to and including terminal units, plus all return air ductwork. Construction of all ducts shall be in accordance with High Velocity Construction Standards as published by SMACNA. All round and rectangular duct construction, duct fittings, dampers, etc., are covered in this manual and it is to be adhered to.
  - 1. Spiral wound round duct shall be as manufactured by United McGill Sheet Metal Company or approved equal.
  - 2. The metal gauges are listed herein for round duct and for rectangular duct.

- B. All ductwork (except welded exhaust duct) shall be sealed with either "MP" (Multi-Purpose), Hardcast "Iron-grip 601", or "United Duct Seal" (United McGill Corp.) water base, latex or acrylic type sealant. Note that, except as noted, oil or solvent based sealants are specifically prohibited for use on this project. For exterior applications, "Uni-Weather" (United McGill Corp.) solvent based sealant shall be used. No other sealants may be used. All seams and joints in shop and field fabricated ductwork shall be sealed by applying one layer of sealant, then immediately spanning the joint with a single layer of 3" wide open weave fiberglass tape. Sufficient additional sealant shall then be applied to completely imbed the cloth. At contractor's option Hardcast 1602 sealant tape may be used in lap joints and flat seams.
- C. Oval ducts shall be spiral flat oval or welded flat oval equal to those of United McGill Sheet Metal Company with gauges and reinforcing as recommended by the manufacturer for medium pressure or the ducts may be Shop fabricated of completely welded construction of the following gauge:
- |                      |              |
|----------------------|--------------|
| Major Axis 12 to 20  | No. 24 gauge |
| Major Axis 20 to 30  | No. 22 gauge |
| Major Axis 30 to 46  | No. 20 gauge |
| Major Axis 46 to 50  | No. 18 gauge |
| Major Axis 50 and Up | No. 16 gauge |
- D. Oval fittings shall be equal to those of United McGill Sheet Metal Company with requirements, sealing, etc., similar to that specified for round medium pressure work.
- E. Oval duct reinforcing methods shall be submitted as Shop Drawings for approval. Reinforcing galvanized angles shall be of sizes specified for same size rectangular ducts. Galvanized angles shall be used where standing seams are specified for rectangular ducts. Attaching methods shall be shown on Shop Drawings and submitted for approval.
- F. Testing of Medium Pressure Ductwork: (Includes from fan discharge through to the discharge of terminal units.)
1. All medium pressure ducts shall be pressure tested according to SMACNA Chapter 10 test procedures. Design pressure for testing ductwork shall be six inches (6") of water. Total allowable leakage shall not exceed 1% of the total system design air flow rate. When partial sections of the duct system are tested, the summation of the leakage for all Sections shall not exceed the total allowable leakage.
  2. The entire system of medium pressure ductwork shall be tested, including the VAV/Constant Volume Terminal Units (i.e. The ductwork shall be capped immediately prior to the Terminal Units, and tested as described above). After testing has proven that the ductwork is installed and performs as specified, the terminal units shall be connected to the ductwork and the connections sealed with extra care. The contractor shall inform the project inspector when the joints may be visually inspected for voids, splits, or improper sealing of the joints. If any leakage in the terminal unit connections/joints after the systems have been put into service, the leaks shall be repaired by: 1) complete removal of the sealing materials, 2) thorough cleaning of the joint surfaces, and 3) installation of multiple layers of sealing materials.
  3. At the option of the Owner, the Contractor may be allowed to eliminate the terminal units from testing by capping the supply ductwork prior to the terminal units, then inspecting the connection to the terminal units when complete. This option may only

be exercised by the Resident Construction Manager, and then only if documented in writing prior to testing.

- G. All exhaust ductwork, including toilet room exhausts, shall be constructed as for medium pressure ducts and shall be tested for leaks in the same manner as for medium pressure supply ducts.
- H. Contractor may at his option use DUCTMATE or Ward coupling system on rectangular ductwork. Contractor may at his option (where space permits) use rectangular ductwork with DUCTMATE or Ward system in lieu of oval ductwork. No other flange-type duct joining systems may be used without written approval from OFPC Engineering.
- I. Rectangular 90 degree elbows shall be constructed with single thickness turning vanes. Radius type rectangular elbows shall have a centerline radius of 1-1/2 times the duct diameter or width. Contractor shall have the option to substitute short radius vaned elbows, but shall request the substitution at the time of submittal of Shop Drawings, and shall request the substitution as required in Section 23 00 00. Elbows in round or oval ducts may be smooth long radius as described above or 5-piece 90 degree elbows and 3-piece 45 degree elbows. Joints in round ducts shall be slip type with a minimum of three sheet metal screws. Joints in sectional elbows shall be sealed as specified for duct sealing.

#### **2.04 ELBOWS:**

- A. Where rectangular elbows are shown, or are required for good air flow, contractor shall provide and install turning vanes. Job fabricated turning vanes, if used, shall be fabricated of the same gauge and type of material as the duct in which they are installed. Vanes must be fabricated for same angle as duct offset. Radius elbows shall have a centerline radius of not less than one and one-half (1-1/2) times the duct width. Submit Shop Drawings on factory fabricated and job fabricated turning vanes. Provide turning vanes in all rectangular radius elbows and offsets.
- B. All turning vanes shall be anchored to the cheeks of the elbow in such a way that the cheeks will not breathe at the surfaces where the vanes touch the cheeks. In most cases, this will necessitate the installation of an angle iron support on the outside of the cheek parallel to the line of the turning vanes.
- C. Where turning vanes are to be provided and installed as required above, in ducts of over 12" thickness (vanes are over 12" long), contractor shall provide and install Tuttle and Bailey double thickness vanes or approved equal. The installation of the turning vanes shall be as described for single thickness vanes.

#### **2.05 FLEXIBLE DUCTS:**

- A. Low Pressure Insulated Flexible Duct may be used where shown on the drawings. Duct shall be made with factory preinsulated duct composed of dead soft, spiral wound, triple locked corrugated aluminum core covered with a minimum of 1-1/2" thick, 3/4 lb. density fiberglass blanket sheathed in a vapor barrier of fiberglass reinforced aluminum foil and mylar laminate. The insulation shall have a minimum "K" factor of 0.29 at 60 degrees F. mean and a vapor barrier permeability rating of 0.05 per ASTM method E96-66, Procedure A. The C factor shall be 0.24 to meet HUD requirements. The duct shall be rated for a positive working pressure of 10" w.g. and a temperature of up to 250 degrees F. The duct must comply with the latest NFPA Bulletin 90A and be listed and labeled by Underwriters Laboratories, Inc., as Class I Air Duct, Standard 181, and meet GSA, FHA and other U. S. Government standards; flame spread, not over 15; smoke developed, not over 10. Flexible



ducts shall be not more than 5'-0" in length, shall be installed as indicated in the diffuser connection detail, and shall be Flexmaster Type TL-M or approved equal.

1. The terminal ends of the duct core shall be secured by compression coupling or stainless steel worm gear type clamp equal to Ideal Series 56 Snaplock. The fittings on air mixing devices and on sheet metal duct shall be coated with the sealant specified for low pressure ductwork, then flexible duct core slipped over duct and coupling or clamp tightened, then connection sealed with more sealant. Insulation of flexible duct shall be slipped over connection to point where insulation abuts mixing box or insulation on duct. These insulation connections shall be sealed by imbedding fiberglass tape in the sealant specified for medium pressure ductwork and coating with more sealant to provide a vapor barrier. (This applies to all flex connections to diffusers, grilles, etc. when allowed on the drawings.)
- B. Medium and High Pressure Insulated Flexible Duct shall be the same construction as the Low Pressure Duct, factory applied insulation of 1" minimum thickness, 3/4 lb. density with a permeability rating of 0.30. The duct shall be supported by a corrosion resistant metal spiral, or a coated spring steel helix and solid inner liner mechanically interlocked or permanently bonded to the helix wire. Ratings shall be as described for Low Pressure Duct above. Flexible ducts shall be not more than 2'-0" in length, used for alignment or sound/vibration purposes only, and may only be installed in straight runs. Flexible duct shall NOT be used for changes of direction of air flow. Installation, clamps and sealing shall be the same as specified for rigid duct.

**2.06 DUCT LINER: NOTE: ALL DUCTWORK SHALL BE EXTERNALLY INSULATED UNLESS OTHERWISE INDICATED ON THE PROJECT DRAWINGS.**

**PART 3 EXECUTION**

**3.01 INSTALLATION**

- A. Refer also to requirements included in Part 2 of this specification.
- B. Obtain manufacturer's inspection and acceptance of fabrication and installation of fiberglass ductwork prior to beginning of installation.
- C. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
- D. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- E. Slope underground ducts to plenums or low pump out points at 1:500. Provide access doors for inspection.
- F. Coat buried, metal ductwork without factory jacket with one coat and seams and joints with additional coat of asphalt base protective coating.
- G. Set plenum doors 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.

- H. Connect terminal units to medium or high pressure ducts directly or with two feet maximum length of flexible duct. Do not use flexible duct to change direction. Allow for a minimum of 3 diameters of straight duct to the entrance of all terminal units.
- I. Connect diffusers with 5'-0" maximum length or troffer boots with 2' maximum length of flexible duct to low pressure ducts. Hold in place with strap or clamp, and seal as specified.
- J. Provide residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for cleanout. Use stainless steel for ductwork exposed to view and stainless steel or galvanized steel for ducts where concealed.
- K. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

**3.02 LOW PRESSURE DUCT SUPPORTS:**

- A. See Section 23 05 29.

**3.03 MEDIUM PRESSURE DUCT SUPPORTS:**

- A. See Section 23 05 29.

**3.04 DUCTWORK APPLICATION SCHEDULE**

AIR SYSTEM MATERIAL

Low Pressure Supply (Heating Systems)	Steel
Low Pressure Supply (Systems with Cooling Coils)	Steel
Medium and High Pressure Supply	Steel
Return and Relief	Steel
General Exhaust	Steel

**3.05 CLEANING OF SYSTEMS:**

- A. Before turning the installation over to the Owner, all ducts should be cleaned and blown free of all dust and dirt that has collected in the ducts.

**3.05 DUCTWORK TESTING:**

- A. All ductwork shall be pressure tested per SMACNA test procedures.

**END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

**SECTION 23 33 00**  
**DUCTWORK ACCESSORIES**

**PART 1 GENERAL**

**1.00 The following sections are to be included as if written herein:**

- A. Section 23 00 00 – Basic Mechanical Requirements
- B. Section 23 05 29 – Sleeves, Flashings, Supports and Anchors
- C. Section 23 05 53 – Mechanical Identification

**1.01 WORK INCLUDED**

- A. Manual and Automatic Volume Control Dampers
- B. Fire Dampers
- C. Combination Fire/Smoke Dampers
- D. Backdraft Dampers
- E. Air Turning Devices
- F. Flexible Duct Connections
- G. Duct Access Doors
- H. Duct Test Holes

**1.02 RELATED WORK**

- A. Products installed, but not furnished under this section include airflow stations and automatic control dampers to be provided by Controls Contractor under section 23 09 23.
- B. Section 23 05 48 - Vibration Isolation
- C. Section 23 31 00 - Ductwork
- D. Section 23 36 00 - Air Terminal Units: Medium and High Pressure Damper Assemblies

**1.03 REFERENCES**

- A. NFPA 90A - Installation of Air Conditioning and Ventilating Systems
- B. SMACNA - Low Pressure Duct Construction Standards
- C. UL 33 - Heat Responsive Links for Fire Protection Service
- D. UL 555 - Fire Dampers and Ceiling Dampers

#### **1.04 SUBMITTALS**

- A. Submit shop drawings and product data under provisions of Section 23 00 00.
- B. Provide shop drawings for shop fabricated assemblies indicated, including manual volume dampers, automatic control dampers, duct access doors, and duct test holes. Provide product data for hardware used.
- C. Submit manufacturer's installation instructions under provisions of Section 23 00 00 for fire dampers and combination fire and smoke dampers.

#### **PART 2 PRODUCTS**

##### **2.01 DAMPERS**

- A. Furnish and install manual volume dampers where shown on the drawings and wherever necessary for complete control of the air flow, including all supply, return and exhaust branches, "division" in main supply, return and exhaust ducts, each individual air supply outlet and fresh air ducts. Where access to dampers through a fixed suspended ceiling is necessary, the Contractor shall be responsible for the proper location of the access doors.
- B. Splitter dampers shall be fabricated of steel not lighter than 16-gauge. The leading edge of the damper shall be hemmed. Each splitter shall be a minimum of 12" long or 1-1/2 times the width of the smaller of the two branches it controls, whichever is greater. Dampers shall be carefully fitted, and shall be controlled by locking quadrants equal to Ventlok No. 555 on exposed uninsulated ductwork, No. 644 on exposed externally insulated ductwork and No. 677 (2-5/8" diameter) chromium plated cover plate for concealed ductwork not above lay-in accessible ceilings. Furnish and install end bearings for the damper rods on the end opposite the quadrant when No. 555 or No. 644 regulators are used, and on both ends when No. 677 regulators are used.
- C. On concealed ductwork above lay-in accessible ceilings use Ventlok No. 555 or No. 644 locking quadrant for splitter dampers.
- D. Dampers larger than three (3) square feet in area shall be controlled by means of rods hinged near the leading edge of the damper with provisions for firmly anchoring the rod and with end bearings supporting the axle.
- E. Manual volume dampers shall be equal to Ruskin, or approved equal. Blades shall not exceed 48 inches (48") in length or twelve inches (12") in width and shall be of the opposed interlocking type. The blades shall be of not less than No. 16-gauge galvanized steel supported on one-half inch (1/2") diameter rust-proofed axles. Axle bearings shall be the self-lubricating ferrule type.
- F. Install all automatic control dampers, furnished by the Temperature Control Manufacturer, in strict accordance with the manufacturer's recommendations and requirements of these Specifications.
- G. All adjustable dampers installed in externally insulated ductwork shall be installed with Ventlok No. 639, or equal, elevated dial operators. Insulation shall extend under the elevated dial. All adjustable dampers installed in internally insulated ductwork shall be

installed with Ventlok No. 635, or equal, dial operators. All damper shaft penetrations in the ductwork shall be installed with Ventlok #609 end bearings.

## **2.02 FIRE AND FIRE/SMOKE DAMPERS**

### **A. Fire Dampers**

1. Furnish and install where shown on the drawings or required by the Specifications, fire dampers meeting the following requirements.
2. Each fire damper shall be constructed and tested in accordance with Underwriters Laboratories Safety Standard 555. All dampers shall possess a 1-1/2 hour or 3 hour (as appropriate for the construction shown in the architectural drawings) protection rating, 165 or 212 degree F fusible link, and shall bear a U.L. label in accordance with Underwriters Laboratories labeling procedures. Fire dampers shall be constructed such that the damper frame material and the curtain material shall be galvanized.
3. Fire dampers shall be curtain blade or multi-blade type and the damper shall be so constructed that the blades are either out of the air stream or installed in an oversized sleeve to provide a 100 percent free area of the duct in which the damper is housed.
4. The damper manufacturer's literature submitted for approval prior to the installation shall include performance data developed from testing in accordance with AMCA 500 Standards and shall show the pressure drops for all sizes of dampers required at anticipated airflow rates. Maximum pressure drop through fire damper shall not exceed 0.05 inch water gauge.
5. Fire dampers shall be equipped for vertical or horizontal installation as required by the locations shown in the drawings. Fire dampers shall be installed in wall and floor openings utilizing steel sleeves, angles and other material and practices required to provide an installation equivalent to that utilized by the manufacturer when the respective dampers were tested by Underwriters Laboratories. Mounting angles shall be a minimum of 1 1/2 inch by 1 1/2 inch by 14-gauge and bolted, tack welded or screwed to the sleeve at maximum spacing of 12 inches and with a minimum of two connections at all sides. Mounting angles shall overlap at least equal to the gauge of the duct defined by the appropriate SMACNA Duct Construction Standard, latest edition, and as described in NFPA 90A. The entire assembly, following installation, shall be capable of withstanding 6" water gauge static pressure.
6. The damper installation shall be in accordance with the damper manufacturer's instructions.
7. All fire dampers shall comply with the specification as written above and shall be Greenheck model DFD-150 or DFDR-150 (type C, CR or CO), Ruskin model DIBD2 (Style C, CR or CO), Nailor model D0120 or D0130, or Pottorff model VFD-10D-A.
8. The contractor shall completely seal the assembly to the building components using Hardcast 1602 sealant tape to allow for expansion and contraction of the sleeve and damper assembly.

9. Dampers shall be UL labeled for use in dynamic systems. Closure reading shall be 110% of the maximum design airflow at the point of installation. The minimum closure pressure rating shall be 8" wg for airflow in either direction.

B. Combination Fire/Smoke Dampers

1. Furnish and install where shown on the drawings, or as required by the specifications, combination fire/smoke dampers meeting the following requirements.
2. Each combination fire/smoke damper shall be 1 1/2 hour fire rated under UL Standard 555, 4th Edition, and shall be further classified by Underwriters Laboratories as a Leakage Rated Damper for use in smoke control systems under the latest version of UL555S, and bear a UL label attesting to it. The damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this specification. Testing and UL qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be no higher than Leakage Class I (4 cfm per square foot at one inch water gauge pressure and 8 cfm per square foot at 4 inches water gauge pressure). The maximum air pressure drop through each combination fire/smoke damper shall not exceed 0.10 inch water gauge at the design air quantity. (Note that this may require a larger damper than the connected duct size.)
3. The damper frame shall be a minimum of 20-gauge galvanized steel formed into a structural hat channel shape with tabbed corners for reinforcement, as approved in testing by Underwriters Laboratories. Bearings shall be integral high surface area non electrolytic materials construction to incorporate a friction free frame blade lap seal, or molybdenum disulfide impregnated stainless steel or bronze oilite sleeve type turning in an extruded hole in the frame or an extruded frame raceway. The dampers may be either parallel or opposed blade type. The blades shall be constructed with a minimum of 14-gauge equivalent thickness. The blade edge seal material shall be able to withstand 450 degrees F. The jamb seals shall be flexible stainless steel compression type or lap seal type.
4. In addition to the leakage ratings specified herein, the combination fire/smoke dampers and their operators shall be qualified under UL555S to an elevated temperature of 250 degrees F. Electric operators shall be installed by the damper manufacturer at the time of damper fabrication. The damper and operator shall be supplied as a single entity that meets all applicable UL555 and UL555S qualifications for both dampers and operators. The manufacturer shall provide a factory-assembled sleeve. The sleeve shall be a minimum of either 20-gauge for dampers where neither width nor height exceeds 48 inches or 16-gauge where either dimension equals or exceeds 48 inches.
5. As part of the UL qualification, dampers shall have demonstrated a capacity to operate (open and close) under HVAC system operation conditions, with pressures of at least 4 inches water gauge in the closed position, and 2500 fpm air velocity in the open position.
6. Each combination fire/smoke damper shall be equipped with a UL Classified Firestat/releasing device. The Firestat/releasing device shall electrically and mechanically lock the damper in a closed position when the duct temperatures exceed 165 degrees F and still allow the appropriate authority to operate the damper as may be required for smoke control functions. The damper must be operable while the temperature is above 250 degrees F. The actuator/operator

package shall include two damper position indicator switches linked directly to damper blade to provide capability of remotely indicating damper position. One switch shall close when the damper is fully open, and the other switch shall close when the damper is fully closed. The Firestat/releasing device and position indicator switches shall be capable of interfacing electrically with the smoke detectors, building fire alarm systems, and remote indicating/control stations.

7. The damper releasing device shall be mounted within the airstream. The device shall be activated and the damper shall close and lock when subjected to duct temperatures in excess of approximately 285 degrees F.
8. Motors for operation of smoke dampers shall be smoke system fail safe, spring return normally open supplies and normally closed returns, or as indicated in the plans, and shall be furnished and installed by the damper manufacturer as required by the U.L. rating mentioned above. Motors shall be electric or pneumatic to match the type of temperature control system specified elsewhere in this specification. All required relays, EP switches, wiring piping and other labor and material necessary to completely interconnect the smoke detector system shall be furnished by the Contractor.
9. Each damper shall be furnished in a square or rectangular configuration. The Contractor shall furnish and install sleeves manufactured by the approved damper manufacturer for each damper. The sleeves shall be constructed with square or rectangular to square, rectangular, round, or oval adapters as required. Dampers shall be installed in the sleeves in accordance with manufacturers U.L. installation instructions. The entire assembly, following installation, shall be capable of withstanding 6" W.G. static pressure.
10. All combination fire/smoke dampers shall comply with the specification as written above and shall be Greenheck model FSD-33, Ruskin model FSD-60, Nailor model 1220, or Pottorff model FSD-151.
11. The contractor shall completely seal the assembly to the building components using Hardcast 1602 sealant tape to allow for expansion and contraction of the sleeve and damper assembly.
12. Dampers shall be UL labeled for use in dynamic systems. Closure reading shall be 110% of the maximum design airflow at the point of installation. The minimum closure pressure rating shall be 8" wg for airflow in either direction.

C. Submittal and Installation

1. Submittal(s) for fire and combination fire/smoke dampers shall include the following:
  - a. Assign identification numbers for each damper with corresponding number noted on the drawings.
  - b. Provide air quantity, size, free area of damper, pressure drop and proposed velocity through each damper.
  - c. Provide manufacturer's data of damper and its accessories or options.
2. One sample 18" x 12" damper shall be furnished for the purpose of illustrating damper operation to the Owner's operating and maintenance personnel.

3. Access doors as specified elsewhere shall be provided to make all parts of the damper accessible. Doors shall open not less than 90 degrees following installation and shall be insulated type where installed in insulated ducts.
4. Contractor shall install each damper square and true to the building. The installation shall not place pressure on the damper frame, but shall enclose the damper as required by UL555.
5. After each fire damper and combination fire and smoke damper has been installed and sealed in their prescribed openings and prior to the installation of the ceilings, the Contractor shall, as directed by the Construction Inspector, activate part or all the dampers as required to verify "first-time" closure. Activation of the damper shall be accomplished by manually operating the resettable link, disconnecting the linkage at the fusible link of the fire damper, and manually operating the fire/smoke damper through the pneumatic or electronic controls as appropriate. Failure of the damper to close properly and smoothly on the first attempt will be cause to replace the entire damper assembly.

### **2.03 FLEXIBLE CONNECTIONS**

- A. Where ducts connect to fans, including roof exhausters, flexible connections shall be made using Ventglas fabric that is fire-resistant, waterproof, mildew resistant and practically air tight, and shall weigh approximately thirty ounces (30 oz.) per square yard. There shall be a minimum of one-half inch (1/2") slack in the connections, and a minimum of two and one-half inches (2-1/2") distance between the edges of the ducts except that there shall also be a minimum of one inch (1") of slack for each inch of static pressure on the fan system. This does not apply to Air Handling Units with internal isolation.

### **2.04 ACCESS DOORS**

- A. Furnish and install in the ductwork, hinged rectangular or round spin-in access doors to provide access to all fire dampers mixed air plenums, upstream of steam reheat coils, automatic dampers, etc. Where the ducts are insulated, the access doors shall be double skin doors with one inch (1") of insulation in the door. Where the size of the duct permits, the doors shall be eighteen inches (18") by sixteen inches (16"), or eighteen inches in diameter, and shall be provided with Ventlok No. 260 latches (latches are not required in round doors). Latches for rectangular doors smaller than 18" x 16" shall be Ventlok No. 100 or 140. Doors for zone heating coils shall be Ventlok, stamped, insulated access doors, minimum 10" x 12", complete with latch and two (2) hinges, or twelve inches (12") in diameter. Round access doors shall be "Inspector Series" spin-in type door as manufactured by Flexmaster USA, or approved equal. Doors for personnel access to ductwork shall be nominal twenty-four inches (24") in diameter.
- B. Where these access doors are above a suspended ceiling, this Contractor shall be responsible for the proper location of the ceiling access doors.

### **2.05 SCREENS**

- A. Furnish and install screens on all duct, fan, etc., openings furnished by this Contractor that lead to, or are, outdoors. Screens shall be No. 16-gauge, one-half inch (1/2") mesh in removable galvanized steel frame. Provide safety screens meeting OSHA requirements for protection of maintenance personnel on all fan inlets and fan outlets to which no ductwork is connected.



## **2.06 TEST OPENINGS**

- A. Furnish and install in the return air duct and in the discharge duct of each fan unit Ventlok No. 699 instrument test holes. The test holes shall be installed in locations as required to measure pressure drops across each item in the system, e.g., O.A. louvers, filters, fans, coils, intermediate points in duct runs, etc.

## **2.07 LOW PRESSURE TAPS (Conical Bell Mouth Fittings)**

- A. Conical fittings may be used for duct taps and shall include quadrant dampers on all lines to air devices (diffusers and grilles), even though a volume damper is specified for the air device. (This does not apply to medium pressure duct.) Spin-in fittings shall be sealed at the duct tap with a gasket, or compression fit, or sealed with sealant specified for medium pressure ductwork. The location of spin-in fittings in the ducts shall be determined after dual or single duct terminal units are hung or the location of the light fixtures is known to minimize flexible duct lengths and sharp bends.
- B. The conical fitting shall be made of at least 26-gauge galvanized sheet metal. The construction to be a two-piece fitting with a minimum overall length of 6 inches and shall be factory sealed for high pressure requirements. Average loss coefficient for sizes 6, 8, and 10 shall be less than 0.055.
- C. Each fitting shall be provided with a minimum 24-gauge damper plate with locking quadrant operator and sealed end bearings. Damper blade shall be securely attached to shaft to prevent damper from rotating around shaft.
- D. Provide flange and gasket with adhesive peel-back paper for ease of application. The fitting shall be further secured by sheet metal screws spaced evenly at no more than 4 inches on-center with a minimum of four screws per fitting.
- E. The conical bellmouth fitting shall be Series 3000G as manufactured by Flexmaster U.S.A., Inc., or Buckley Air Products, Inc., 'AIR-TITE'.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install accessories in accordance with manufacturer's instructions.
- B. Provide balancing dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Use splitter dampers only where indicated.
- C. Provide balancing dampers on medium and high pressure systems where indicated. Refer to Section 23 36 00 - Air Terminal Units.
- D. Provide fire dampers, and combination fire and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

- E. Demonstrate re-setting of fire dampers to Owner's representative.
- F. Provide backdraft dampers on exhaust fans or exhaust ducts where indicated.
- G. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment. Cover connections to medium and high pressure fans with leaded vinyl sheet, held in place with metal straps.
- H. Provide duct access doors for inspection and cleaning before and after duct mounted filters, coils, fans, automatic dampers, at fire dampers, and elsewhere as indicated. Provide minimum 8 x 8 inch (200 x 200 mm) size for hand access, 18 x 18 inch (450 x 450 mm) size for shoulder access, and as indicated.
- I. Provide duct test holes where indicated and where required for testing and balancing purposes. Refer also to Section 23 05 93.B.

**END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

## **SECTION 23 36 00**

### **AIR TERMINAL UNITS (VAV)**

#### **PART 1 GENERAL**

##### **1.00 The following sections are to be included as if written herein:**

- A. 23 00 00 -- Basic Mechanical Requirements
- B. 23 05 29 -- Sleeves, Flashings, Supports and Anchors
- C. 23 05 53 -- Mechanical Identification

##### **1.01 SECTION INCLUDES**

- A. Variable Volume Terminal Units
- B. Constant Volume Exhaust Terminal Units
- C. Integral Damper Motor Operators
- D. Integral Controls

##### **1.02 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION**

- A. Section 23 09 23 – Direct Digital Control Systems
- B. Section 23 05 93.A - Testing, Adjusting and Balancing
- C. Section 26 05 19 - Cable, Wire and Connectors, 600 Volt
- D. Section 26 27 26 - Wiring Devices

##### **1.03 RELATED SECTIONS**

- A. Section 23 05 13 - Motors
- B. Section 23 31 00 - Ductwork
- C. Section 23 33 00 - Ductwork Accessories
- D. Section 23 05 93.A - Testing, Adjusting and Balancing
- E. Section 26 05 19 - Cable, Wire and Connectors, 600 Volt
- F. Section 26 27 26 - Wiring Devices

##### **1.04 REFERENCES**

- A. NFPA 90A - Installation of Air Conditioning and Ventilation Systems
- B. UL 181 - Factory-Made Air Ducts and Connectors
- C. ADC 1062 - Air Distribution and Control Device Test Code

- D. ARI 880 - Standard for Air Terminals

#### **1.05 SUBMITTALS**

- A. Submit shop drawings under provisions of Section 23 00 00.
- B. Submit shop drawings indicating configuration, general assembly, and materials used in fabrication.
- C. Submit product data under provisions of Section 23 00 00.
- D. Submit product data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings which indicate airflow, static pressure, and NC designation.
- E. Include schedules listing discharge and radiated sound power level for each of second through seventh octave bands at inlet static pressures of one inch wg.
- F. Submit Manufacturer's installation instructions under provisions of Section 23 00 00.

#### **1.06 OPERATION AND MAINTENANCE DATA**

- A. Submit operation and maintenance data under provisions of Section 23 00 00.
- B. Include Manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists.

#### **1.07 QUALIFICATIONS**

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

#### **1.08 WARRANTY**

- A. Provide one-year Manufacturer's warranty under provisions of Section 23 00 00.

### **PART 2 PRODUCTS**

#### **2.01 VARIABLE VOLUME TERMINAL UNITS:**

The Contractor shall furnish and install pressure independent single duct variable air volume control assemblies), of the sizes, capacities and configurations shown on the Drawings.

- A. CASING CONSTRUCTION:

- 1. The units shall be constructed of a minimum of 22-gauge galvanized steel and internally lined with a minimum of 1 inch thick, three pound per cubic foot density insulation. The insulation shall be foil faced with the edges and seams sealed or "captured", encapsulating all fibers of the insulation. The insulation shall be neatly installed with no rough edges to interrupt the smooth flow of air through the box. Closed cell polymer insulation may be used instead of the fiberglass described above if UL 25/50 labeled. The casing shall be insulated throughout its interior, up to or at least to within 2" of the heating coil connection. Insulation for the heating coil shall enclose the coil casing and tube bends and shall overlap the box internal

lining by at least 3". The external insulation shall be as specified in other sections of this specification for duct insulation with full vapor barrier, and shall be field installed unless coil and plenum section is furnished as an integral part of the box.

2. All interior features of the boxes (such as mixing baffles, damper housings, etc.) shall be secured within the casing to avoid excessive movement or rattling with air movement or externally generated vibration. All external features of the terminal units shall be designed not to extend beyond the ends of the unit. (For example, the actuator mounting brackets, etc. shall not extend beyond the plane of the inlet "bulkhead.") The only exception shall be flow sensors installed in the inlet duct connections. Note that if a separate flow station is installed within a frame within the casing, then it shall be so installed not to allow airflow to bypass the flow measurement station.
3. The terminal units shall be constructed with inlet and discharge ductwork connections. The inlet ductwork connections shall extend a minimum of 4 inches from the unit casing including an allowance for the installation of airflow station(s) or probe(s). The discharge connection shall include 1" extension with slip and drive connections for use by the Contractor to secure the discharge ductwork or appurtenances to the unit and shall be reinforced to provide a rigid assembly.

B. CASING LEAKAGE: Assembled units shall be so constructed and sealed to limit air leakage to the following listed quantities at 6" static pressure. If sealing is required to obtain the leakage performance, seal as for medium pressure ductwork Hardcast 1602 tape may be used to seal lap joints and flat seams only. Leakage curves or tables will be required as part of the submittal data. The following is the maximum allowable casing leakage including all components:

<u>Diameter</u>	<u>Maximum Allowed CFM (Area x 2000 fpm)</u>	<u>Maximum Allowable CFM Casing Leakage</u>
4"-5"-6"	393	8.0
7"-8"	698	14.0
9"-10"	1091	22.0
11"-12"	1571	30.0
13"-14"	2138	40.0

C. ACCESS PLENUM AND DOOR: Single duct units provided with reheat coils also shall be provided with an access section or plenum between the terminal and the coil for coil inspection. The construction of the plenum shall be equal to the quality of materials and workmanship to that of the terminal unit. The access plenum may also be used as a transition, and shall be constructed with a transition angle not to exceed 15 degrees. The access plenum shall contain a minimum of a 12 inch diameter or 12 inch by 12 inch (or full width of unit if less than 12") access door as manufactured by Ventlok, Flexmaster Inspector, Ward or equal. Door frame may be bolted, screwed or flanged and sealed to the casing. Door shall be gasketed and shall be double wall construction or insulated similar to main casing. Door shall be held in place with latches or other captive retainer devices. An additional access panel shall be provided immediately downstream of the dampers for inspection and service of the dampers. If the damper assembly is easily removed from the rear of the box, the access size can be reduced to 8" round or 8" x 8" for inspection only.

D. DAMPER CONSTRUCTION: The damper blades shall be an equivalent of 18-gauge galvanized steel or equal aluminum and shall be securely riveted or bolted through the damper shafts to assure no slippage of the blades. The damper shafts shall operate in rust-proof self-lubricating bearings. Damper shafts penetrating the unit casings shall be

sealed against leakage, and bearings shall be installed for protection against wear in the casing penetration. Damper shafts shall be formed of, or cut from solid stock; no hollow shafts will be allowed. The dampers shall seat against gasketed stops or the dampers shall have gasketed edges. Gaskets shall be mechanically fastened to the blades. If the fastening method is not full contact clamping type, then the addition of adhesive to the gasket shall be required. The dampers shall be so constructed to prevent "oil canning" of the damper blade. The units shall be tested for leakage in both inlets with 6" static pressure imposed on one inlet at a time. The maximum percent leakage from all tests shall be reported. Leakage curves as a function of pressure shall be supplied as part of the submittal data. The damper actuator linkage, if used, shall be constructed of material of sufficient strength to avoid buckling under extreme loads. Also, linkages shall not allow play greater than 5 degrees of damper movement. The controls for the dampers shall cause the dampers to fail in the position of last control (freeze in place), or fail to the open position.

- E. DAMPER LEAKAGE: The following is the maximum damper leakage allowable for the various size diameter inlets at 6" wg differential pressure. The damper leakage shall not exceed the values listed in the table below at 6" S.P., following ARI 880 Testing Procedures.

<u>Diameter</u>	<u>Maximum Allowed CFM (Area x 2000 fpm)</u>	<u>Maximum Allowable CFM Damper Leakage</u>
4"-5"-6"	393	6.0
7"-8"	698	10.5
9"-10"	1091	16.5
11"-12"	1571	20.0
13"-14"	2138	30.0

- F. UNIT PRESSURE DROP: For dual duct units with an integral attenuator-mixer, but with no other accessories, the static pressure across the assembly with an equivalent 2000 fpm inlet velocity through one inlet shall not exceed 0.50 inches water gauge, with the total flow through either inlet. Single duct unit pressure drop shall be limited to 0.15 inches water gauge under the same conditions above.

- G. CERTIFICATION: The Unit Manufacturer shall certify that each unit used on this project will perform as specified. Each unit shall bear a tag or decal listing the following specified information:

1. Test Pressure
2. Leakage CFM (damper)
3. Leakage CFM (casing)
4. Date of Mfg.
5. Room or area served
6. Unit size - 6", 8", etc.
7. Calibrated CFM, i.e. 800 CFM

- H. FLOW MEASUREMENT: Airflow thru the unit shall be accomplished by the use of a multi-port sensing device with a minimum of four radially distributed pick-up points connected to a center averaging chamber with adequate internal passages to prevent restrictions that can result in control 'hunting'. On all systems, sensors shall be mounted as required by the temperature controls supplier.

- I. SOUND: (Note that the maximum sound levels listed in this paragraph refer to raw sound levels, with no credits taken for the construction.)

1. DISCHARGE SOUND

Maximum discharge Sound Power Levels at 2000 fpm primary air inlet velocity with 1.5 inch wg inlet static pressure shall not exceed that listed in the following table. No credit for lined discharge duct, branching, flow division, end reflection, room absorption or any other effects shall be allowed.

Octave Band (Hz)	Center Frequency (dB re 10 <sup>-12</sup> Watts)	Sound Power Level
2	125	76
3	250	66
4	500	63
5	1000	58
6	2000	60
7	4000	55

2. RADIATED SOUND

Maximum discharge Sound Power Levels at 2000 fpm primary air inlet velocity with 1.5 inch wg inlet static pressure shall not exceed that listed in the following table. No credit for ceiling plenum, ceiling tiles, room absorption, or any other effects shall be allowed.

Octave Band (Hz)	Center Frequency (dB re 10 <sup>-12</sup> Watts)	Sound Power Level
2	125	72
3	250	67
4	500	64
5	1000	54
6	2000	47
7	4000	45

All sound power levels shall be obtained from testing in accordance with ARI-ADC Standard 880 and shall be certified at ARI-880 certification points.

J. MANUFACTURER: All Terminal Units shall be as manufactured by Titus (Model MDV-3100-UT), Metal\*Aire (Series TH500-ECO), or Nailor Industries (3000-UT). *Note that the model and series numbers listed may differ slightly from catalogue information. No other Manufacturers or models are acceptable.* Even though specific Manufacturers may be named herein, the material supplied by any approved Manufacturer shall meet all of the provisions of this specification without exception.

K. GENERAL PERFORMANCE: Devices using mechanical CFM limiters will not be accepted, nor shall it be necessary to change control components to make airflow rate changes. If used, pneumatic actuator motors, pneumatic controllers, and pneumatic or DDC flow stations shall be furnished, mounted and adjusted by the terminal unit assembly Manufacturer to assure their proper placement within the units. It shall be noted that the terminal unit Manufacturer shall be responsible for the workmanship and materials of the entire assembly of unit and controls if pneumatic controls are specified and supplied with the unit. If DDC controls of another Manufacturer (NOT the terminal unit Manufacturer) are provided for this project, the terminal unit Manufacturer shall be responsible only for the construction of the terminal unit and the installation of internal control components installed at the Manufacturer's factory, and shall not be responsible for the installation of controls not

installed at the terminal unit Manufacturer's factory, nor shall the Manufacturer be responsible for the performance of the DDC controls. The performance of DDC controls, especially in connection with terminal units, shall be the responsibility of the DDC controls Manufacturer.

- L. CONTROL PERFORMANCE: Assemblies shall be able to be reset to any airflow between zero and the maximum cfm shown on Drawings. To allow for maximum flexibility and future changes, it shall be necessary to make only simple screwdriver or keyboard adjustments to arrange each unit for any maximum airflow within the ranges for each inlet size as scheduled on the Drawings. The control devices shall be designed to maintain the desired flow regardless of inlet flow deflection. All terminal units shall be installed with a minimum of four diameters of straight duct directly prior to the entry into each terminal unit connection and of the same size as the box connection.
- M. CONTROL SEQUENCES: The control sequence arrangements shall be as described below, whether the controls used on this project are pneumatic or DDC, and the terminal units shall be shipped from the Manufacturer with all necessary control devices to accomplish each sequence, except as may be prohibited by the controls Manufacturer. The desired sequence shall be adjustable according to space usage or a change in space conditions.
- O. DDC SYSTEMS:
  - 1. Electronic motors and controllers shall be installed by the terminal unit Manufacturer unless specifically prohibited by the by the controls Manufacturer. In such an event, the controls Manufacturer shall be responsible for the installation of the controls. The controls Manufacturer shall be responsible for the operational performance of the entire system. The terminal unit Manufacturer shall remain responsible only for the performance of the mechanical components of the unit.
  - 2. DDC Controls Protocol/Description: Refer to Sequence of Operation on Drawings.

## **2.02 CONSTANT VOLUME EXHAUST VALVES:**

- A. Furnish and install Phoenix pressure independent self-regulating venture exhaust valve as scheduled on the Drawings.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Refer also to requirements included in Part 2 of this specification.
- B. Install in accordance with Manufacturer's instructions.
- C. Provide ceiling access doors or locate units above easily removable ceiling components.
- D. Support units individually from structure. Do not support from adjacent ductwork.
- E. Connect to ductwork in accordance with Section 23 31 00.

### **END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068



## SECTION 26 00 00

### BASIC ELECTRICAL REQUIREMENTS

#### PART 1 - GENERAL

##### 1.1 WORK INCLUDED

- A. General Requirements specifically applicable to Division 26.
- B. The Contractor shall be responsible for:
  - 1. The work included consists of furnishing all materials, supplies, equipment and tools, and performing all labor and services necessary for installation of a completely functional power, lighting, fire alarm and signaling systems. Complete systems in accordance with the intent of Contract Documents.
  - 2. Coordinating the details of facility equipment and construction for all Specification Divisions, which affect the work covered under this Division.
  - 3. Furnishing and installing all incidental items not actually shown or specified, but which are required by good practice to provide complete functional systems.
  - 4. Temporary power service and lighting for construction. Coordinating all shutdown dates and schedules with Owner's Representative and obtain all work-permits required by Owner.
- C. Intent of Drawings:
  - 1. The Drawings are necessarily diagrammatic by their nature, and are not intended to show every connection in detail or every device or raceway in its exact location, unless specifically dimensioned. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the work in order to avoid interference between the various phases of work. The Contractor shall be responsible for the proper routing of raceway, subject to prior review by the Owner and Engineer. Work shall be organized and laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. All work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
  - 2. The intent of the Drawings is to establish the type of systems and functions, but not to set forth each item essential to the functioning of the system. The drawings and specifications are cooperative, and work or materials called for in one and not mentioned in the other shall be provided. Review pertinent drawings and adjust the work to conditions shown. In case of doubt as to work intended, or where discrepancies occur between drawings, specifications, and actual conditions, immediately notify the Architect/Engineer and the Owner's representative, and propose a resolution.

##### 1.2 RELATED WORK

- A. This Section shall be used in conjunction with the following other specifications and related Contract Documents to establish the total general requirements for the project electrical systems and equipment.
  - 1. Division 01 Sections included in the project specifications.
  - 2. The contract.

##### 1.3 DESIGN CRITERIA

- A. Equipment and devices to be installed outdoors or in enclosures where the temperatures are not controlled shall be capable of continuous operation under such conditions per manufacturer's requirements.
- B. Compliance by the Contractor with the provisions of this Specification does not relieve him of the

responsibilities of furnishing equipment and materials of proper design, mechanically and electrically suited to meet operating guarantees at the specified service conditions.

- C. Electrical components shall be UL listed and labeled.

#### **1.4 REFERENCE CODES AND STANDARDS, REGULATORY REQUIREMENTS**

- A. Standards of the following organizations as well as those listed in Division 01, may be referenced in the specification. Unless noted otherwise, references are to standards or codes current at the time of bidding.

1. Association of Edison Illuminating Companies (AEIC)
2. American National Standards Institute (ANSI)
3. Institute of Electrical and Electronics Engineers (IEEE)
4. Insulated Cable Engineers Association (ICEA)
5. National Electrical Code (NEC)
6. National Electrical Manufacturers Association (NEMA)
7. Electrical Safety in the Workplace
8. National Fire Protection Association (NFPA)
9. Underwriter's Laboratories (UL)
10. ASHRAE/IES 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings

- B. Work, materials and equipment must comply with the latest rules and regulations of the following.

1. National Electrical Code (NEC)
2. Electrical Safety in the Workplace
3. Occupational Safety and Health Act (OSHA)
4. American with Disability Act (ADA)
5. American Society for Testing and Materials (ASTM)
6. University of Texas (UT) System
7. Applicable state and federal codes, ordinances and regulations

- C. Discrepancies. The drawings and specifications are intended to comply with listed codes, ordinances, regulations and standards. Where discrepancies occur, immediately notify the Owner's representative in writing and ask for an interpretation. Should installed materials or workmanship fail to comply, the Contractor is responsible for correcting the improper installation. Additionally, where sizes, capacities, or other such features are required in excess of minimum code or standards requirements, provide those specified shown.

- D. Contractor shall obtain permits and arrange inspections required by codes applicable to this Section and shall submit written evidence to the Owner and Engineer that the required permits, inspections and code requirements have been secured.

#### **1.5 SUBMITTALS**

- A. Submit the following in addition to and in accordance with the requirements of Division 01 for submittal requirement.
  1. Include inspection and permit certificates and certificates of final inspection and acceptance from the authority having jurisdiction.

2. Manufacturer's standardized schematic diagrams and catalog cuts shall not be acceptable unless applicable portions of it are clearly indicated and non-applicable portions clearly deleted or crossed out.
  3. All schematic, connection and/or interconnection diagrams in accordance with the latest edition of NEMA.
  4. Provide submittals as required by individual specification Section.
- B. Provide the following with each submittal:
1. Catalog cuts with manufacturer's name clearly indicated. Applicable portions shall be circled and non-applicable portions shall be crossed out.
  2. Line-by-line specification review by equipment manufacturer and contractor with any exceptions explicitly defined.
- C. Equipment Layout Drawing: 1/8-inch scale minimum drawings indicating electrical equipment locations. Dimensions for housekeeping pads should be indicated on these drawings. Indicate routing of conduit 2 inches and over on these drawings.
- D. Within the specified time window after award of contract, submit list of equipment and materials to be furnished.
1. Itemize equipment and material by specification Section number; include manufacturer and identifying model or catalog numbers.
  2. Replace rejected items with an acceptable item within 2 weeks after notification of rejection.
  3. If a satisfactory replacement is not submitted within a two-week period, owner will notify contractor as to equipment manufacturer or type and make or material to be furnished. Provide designated items at no additional cost to owner.
- E. As-Built Record Drawings: The Contractor shall maintain a master set of As-Built Record Drawings that show changes and any other deviations from the drawings. The markups must be made as the changes are done. At the conclusion of the job, these As-Built Record Drawings shall be transferred to AutoCad electronic files, in a format acceptable to the Owner, and shall be complete and delivered to the Owner's Representative prior to final acceptance. Refer to 01210 Project Administration for other requirements.

## **1.6 SAFETY**

- A. The Contractor shall follow the safety procedures in addition to, and in accordance with, the requirements of Project Safety Manual (PSM).
1. The Contractors shall be responsible for training all personnel under their employ in areas concerning safe work habits and construction safety. The Contractor shall continually inform personnel on hazards particular to this project and update the information as the project progresses.
  2. The Contractor shall secure all electrical rooms, to limit access, prior to energizing any high voltage (480V or higher) equipment and shall control access during the project after energization. The Contractor shall post and maintain warning and caution signage in areas where work is on going near energized equipment. The Contractor shall cover all energized live parts when work is not being done in the equipment. This includes lunch and breaks.
  3. The Contractor shall strictly enforce OSHA lock out/tag out procedures. Initial infractions shall result in a warning; a second infraction shall result in the removal of the workman and his foreman from the site. Continued infractions shall result in removal of the Contractor from the site.

## **1.7 SHORING AND EQUIPMENT SUPPORTS**

- A. The Contractor shall provide all permanent and temporary shoring, anchoring, and bracing required to make all parts absolutely stable and rigid; even when such shoring, anchoring, and bracing are not explicitly called for.
- B. The Contractor shall adequately support all freestanding panels, motor control centers, enclosures, and other equipment. This shall include bolting to the floor or solid structural steel to prevent tipping. Install free-standing electrical equipment on 4" thick concrete housekeeping pads that are provided by others. Under no condition shall equipment be fastened to non-rigid building steel (i.e., removable platform steel gratings, handrails, etc.).
- C. The Contractor shall provide racks and supports, independently mounted at structure, to support electrical equipment and systems supplied and installed under this contract. At no time shall the Contractor mount or suspend equipment from other disciplines' supports.

## **1.8 TEMPORARY POWER REQUIREMENTS**

- A. Provide power distribution system sufficient to accommodate construction operations requiring power, use of power tools, electrical heating, lighting, and start-up/testing of permanent electric-powered equipment prior to its permanent connection to electrical system. Provide proper overload protection. Ground fault circuit interrupters (GFCI) are to be used on all 120-volt, single-phase, 15 and 20 amp receptacle outlets where portable tools and equipment are used. Ground fault circuit interrupters shall be tested weekly by the Contractor.
- B. Temporary power feeders shall originate from a distribution panel. The conductors shall be multi-conductor cord or cable per NEC for hard and extra-hard service multi-conductor cord.
- C. Branch circuits shall originate in an approved receptacle or panelboard. The conductors shall be multi-conductor cord or cable per NEC for hard and extra-hard service multi-conductor cord. Each branch circuit shall have a separate equipment grounding conductor.
- D. All receptacles shall be of the grounding type and electrically connected to the grounding conductor.
- E. Provide temporary lighting by factory-assembled lighting strings or by manually-assembled units. All lamps for general lighting shall be protected from accidental contact or breakage. Protection shall be provided by installing the lights a minimum of 7 feet from the work surface or by lamp holders with guards. Branch circuits supplying temporary lighting shall not supply any other load. Provide sufficient temporary lighting to ensure proper workmanship by combined use of day lighting, general lighting, and portable plug-in task lighting. Comply with OSHA required foot-candle levels and submit plan for approval by the owner.
- F. For temporary wiring over 600 volts, suitable fencing, barriers, or other effective means shall be provided to prevent access of anyone other than authorized and qualified personnel.
- G. Temporary power cords shall be kept off the ground or floor. The Contractor shall provide temporary supports as required to keep temporary cords off the ground or floor.

## **1.9 SUBSTITUTION OF MATERIALS AND EQUIPMENT:**

- A. Refer to Uniform General Conditions and Supplementary General Conditions for substitution of materials and equipment.
- B. The intent of the Drawings and/or Specifications is neither to limit products to any particular manufacturer nor to discriminate against an "APPROVED EQUAL" product as produced by another manufacturer. Some proprietary products are mentioned to set a definite standard for acceptance and to serve as a reference in comparison with other products. When a manufacturer's name appears in these Specifications, it is not to be construed that the manufacturer is unconditionally acceptable as a provider of equipment for this project. The

successful manufacturer or supplier shall meet all of the provisions of the appropriate specification(s).

- C. The specified products have been used in preparing the Drawings and Specifications and thus establish minimum qualities with which substitutes must at least equal to be considered acceptable. The burden of proof of equality rests with the Contractor. The decision of the Architect/Engineer is final.
- D. When requested by the Architect/Engineer, the Contractor shall provide a sample of the proposed substitute item. In some cases, samples of both the specified item and the proposed item shall be provided for comparison purposes.
- E. Timeliness: The burden of timeliness in the complete cycle of submittal data, shop Drawings, and sample processing is on the Contractor. The Contractor shall allow a minimum of six (6) weeks time frame for review of each submission by the office of the design discipline involved after receipt of such submissions by that design discipline. The Contractor is responsible for allowing sufficient time in the construction schedule to cover the aforementioned cycles of data processing, including time for all resubmittal cycles on unacceptable materials, equipment, etc. covered by the data submitted. Construction delays and/or lack of timeliness in the above regard are the responsibility of the Contractor and will not be considered in any request for scheduled construction time extensions and/or additional costs to the Owner.
- F. All equipment installed on this project shall have local representation; local factory authorized service, and a local stock of repair parts.
- G. Acceptance of materials and equipment will be based on manufacturer's published data and will be tentative subject to the submission of complete shop Drawings indicating compliance with the contract documents and that adequate and acceptable clearances for entry, servicing, and maintenance will exist. Acceptance of materials and equipment under this provision shall not be construed as authorizing any deviations from the Specifications, unless the attention of the Architect/Engineer has been directed in writing to the specific deviations. Data submitted shall not contain unrelated information unless all pertinent information is properly identified.
- H. Certification: The Contractor shall carefully examine all data forwarded for approval and shall sign a certificate to the effect that the data has been carefully checked and found to be correct with respect to dimensions and available space and that the equipment complies with all requirements of the Specifications.
- I. Physical Size of Equipment: Space is critical; therefore, equipment of larger sizes than shown, even though of specified manufacturer, will not be acceptable unless it can be demonstrated that ample space exists for proper installation, operation, and maintenance.
- J. Should a substitution be accepted, and should the substitute material prove defective, or otherwise unsatisfactory for the service intended within the guarantee period, this material or equipment shall be replaced with the material or equipment specified at no additional cost to the Owner.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS AND EQUIPMENT**

- A. Materials and Equipment: Labeled and/or listed as acceptable to the authority having jurisdiction as suitable for the use intended. Materials shall be of a standard industrial quality if no specifications or specific model numbers are given.
- B. Where two or more units of the same class of material are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.
- C. All materials shall be new and unused.
- D. Provide non-metallic material in corrosive areas or as otherwise specified.

## **PART 3 - EXECUTION**

### **3.1 WORKMANSHIP**

- A. Install work in compliance with NEC latest edition.
- B. Install material and equipment in accordance with manufacturers' instructions. Provide calibrated torque wrenches and screwdrivers and tighten all terminals, lugs, and bus joints using it.
- C. Comply with startup procedures as defined by Construction Manager and Owner.
- D. Arrange electrical work in a neat, well-organized manner. Do not block future connection points of electrical service. Install all electrical work parallel or perpendicular to building lines unless noted otherwise, properly supported with purpose-designed apparatus, in a neat manner.
- E. Apply, install, connect, erect, use, clean, adjust, and condition materials and equipment as recommended by the manufacturers in their published literature.
- F. Make opening through masonry and concrete by core drilling in acceptable locations. Restore openings to original condition to match remaining surrounding materials.

### **3.2 SERVICE CONTINUITY**

- A. Maintain continuity of electric service to all functioning portions of process or buildings during the hours of normal use. Phase construction work to accommodate Owner's occupancy requirements.
- B. Arrange temporary outages for cutover work with the Owner. Keep the outages to a minimum number and minimum length of time.
- C. All service outages shall be requested in writing a minimum of two weeks prior to the date. Owner reserves the right to postpone shutdowns up to 24 hours prior to the shutdown at no additional cost. Outage requests shall include a schedule of the work to be performed and the time requirements.
- D. The Contractor shall obtain all appropriate Owner permits for working in equipment.

### **3.3 HAZARDOUS LOCATIONS**

- A. Equipment, wiring, devices, and other components located within hazardous areas to be of appropriate type per NFPA requirements.
- B. Ground exposed non-current carrying parts of entire electrical system in hazardous areas, in accordance with NEC and as instructed by Owner.

### **3.4 SLEEVES AND SEALS**

- A. Provide sealing and/or fire stopping where electrical equipment passes through walls, ceilings, and floors. Seals shall be watertight and/or fire rated as applicable.

### **3.5 CONSTRUCTION REVIEW**

- A. The Engineer or Owner's representative will review and observe installation work to insure compliance by the Contractor with requirements of the Contract Documents.
- B. Review, observation, assistance, and actions by the Engineer or Owner's representative shall not be construed as undertaking supervisory control of the work or of methods and means employed by the Contractor. The review and observation activities shall not relieve the Contractor from the responsibilities of these Contract Documents.
- C. The fact that the Engineer or Owner's representative do not make early discovery of faulty or omitted work shall not bar the Engineer or Owner's representative from subsequently rejecting this work and insisting that the Contractor make the necessary corrections.
- D. Regardless of when discovery and rejection are made, and regardless of when the Contractor is ordered to correct such work, the Contractor shall have no claim against the Engineer or Owner's

representative for an increase in the Contract price, or for any payment on account of increased cost, damage, or loss.

**3.6 WARRANTY**

- A. Provide warranties in accordance with the requirements of Uniform General and Supplementary Conditions (UGC).

**END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

This Page is Intentionally Blank



## SECTION 26 00 00.01

### ELECTRICAL DEMOLITION

#### PART 1 - GENERAL

##### 1.1 WORK INCLUDED

- A. Electrical demolition for remodeling.
- B. Electrical/control portion of HVAC work covered by Division 23 pertaining electrical demolition shall follow the requirement set forth by this specification.

##### 1.2 RELATED WORK

- A. This Section shall be used in conjunction with the following other specifications and related Contract Documents to establish the total requirements for minor electrical demolition for remodeling.
  - 1. Section 26 00 00 - Basic Electrical Requirements.
- B. In the event of conflict regarding minor electrical demolition requirements between this Section and any other Section, the provisions of this Section shall govern.

#### PART 2 - PRODUCTS

##### 2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: as specified in individual Sections.
- B. Provide all materials necessary for work.

#### PART 3 - EXECUTION

##### 3.1 EXAMINATION

- A. All demolitions or modifications to existing systems shall be coordinated through Owner's Representative. Demolition drawings are based on casual field observation and existing record documentations. Therefore the accuracy or exactness of the drawings is not guaranteed. The Contractor shall verify that field measurements and circuiting arrangements are as shown on Drawings and abandoned wiring and equipment serve only abandoned facilities. The Contractor shall be responsible for reporting discrepancies to Engineer before disturbing existing installation.
- B. Beginning of demolition means Contractor accepts existing conditions.

##### 3.2 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal. Provide temporary wiring and connections to maintain remaining systems in service during demolition and/or modification. Owner reserves the right up to 24 hours prior to any scheduled event to delay or suspend shutdowns or outages to more convenient times at no additional cost.
- B. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. No work shall begin without proper permits and authorizations. Disable system only to make switchovers and connections. Obtain permission from Owner at least (2) weeks before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.
- C. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Notify Owner at least (2) weeks before partially or completely disabling system. Minimize outage duration. Provisions for manual fire watch shall be provided in areas where services are interrupted. Make temporary connections to maintain service in areas adjacent to work area.

- D. Existing Telephone System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Notify Owner at least (2) weeks before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

### **3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK**

- A. Remove, relocate, and extend existing installations to accommodate new plan drawings.
- B. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes full length from source to device. Cut embedded or concealed conduit flush with walls and floors, and patch surfaces.
- C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.
- D. Disconnect and remove abandoned panelboards and distribution equipment.
- E. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- F. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- G. Repair adjacent construction and finishes damaged during demolition and extension work.
- H. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
- I. Extend existing installations using materials and methods compatible with existing electrical installation or as specified.
- J. The level of completion shall be demonstrated to Owner's Representative.
- K. Where equipment is indicated to be demolished and returned to Owner, the Contractor shall include the delivery of this equipment to the Owner's site storage area. Remove with care all equipment to be relocated. Repair or replace of newly damaged equipment is the responsibility of the Contractor.

### **3.4 CLEANING AND REPAIR**

- A. The Contractor shall follow Owner's clean work policy and shall include the removal of trash and demolished material from the building or work area at the end of the each day and removal from the site once a week.
- B. The Contractor shall be responsible for repairing adjacent construction and finishes damaged during demolition and/or modification. The Contractor shall be responsible for the removal of ceiling tiles required in the demolition work. The Contractor shall be responsible for the replacement of damaged tiles and reinstallation of the ceiling prior to final acceptance.
- C. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
- D. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts, and broken electrical parts.

### **3.5 DISPOSITION OF MATERIAL AND EQUIPMENT**

- A. Review with the Owner materials that have been removed and are no longer required, to determine any which the Owner may desire to keep. Deliver those materials that the Owner desires to the Owner's specified location.

- B. For those materials not required by the Owner, dispose of them in accordance with applicable regulations.

**END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

This Page is Intentionally Blank

## SECTION 26 05 00

### BASIC ELECTRICAL MATERIALS AND METHODS

#### PART 1 - GENERAL

##### 1.1 WORK INCLUDED

- A. Hinged cover enclosures and cabinets
- B. Contactors
- C. Control relays
- D. Push buttons, and selector switches
- E. Terminal blocks and accessories
- F. Penetration sealing systems (fire stops)
- G. Electrical/control portion of HVAC work covered by Division 23 pertaining basic electrical materials and methods shall follow the requirement set forth by this specification.

##### 1.2 APPLICABLE CODES AND STANDARDS

- A. NFPA 70, National Electrical Code (latest edition)
- B. American National Standard, National Electrical Safety Code, (latest edition)
- C. Applicable publications of NEMA, ANSI, IEEE, and ICEA
- D. Underwriters Laboratories, Inc. Standards (UL)
- E. Federal, city, state, and local codes and regulations having jurisdiction
- F. OSHA requirements
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
- H. NEMA WD 1 – General-Purpose Wiring Devices
- I. UL 98 - Enclosed Switches

##### 1.3 INTENT

- A. This Section is not, and shall not be interpreted to be, a complete listing of all materials or equipment that is Contractor furnished and erected. It is intended to clarify and further define the Contractor scope of work, procurement, and responsibilities for those incidental materials that are not specified by other specifications, but important to a complete and operational system.
- B. The Contractor shall furnish all equipment and materials, whether or not specified in other Sections of specification and on drawings, for installation and connection required to place equipment into satisfactory operating service. The Contractor shall review the Drawings and specifications for clarification of his responsibility in the handling and installation of equipment and material. Where applicable, and not in contradiction with the Drawings and specifications, the Contractor shall install and connect the equipment in accordance with the manufacturer's recommendations and instructions.
- C. All materials and equipment shall be of types and manufacturer specified wherever practical. Should materials or equipment so specified be unattainable, the Contractor shall submit the description and manufacturer's literature, reason for substitution request and shall secure the approval of the Engineer before substitution of other material or equipment is purchased. This Section establishes performance requirements and the quality of equipment acceptable for use and shall in no way be construed to limit procurement from other manufacturer.

#### **1.4 SUBMITTALS**

- A. Provide submittals in addition and in accordance with Section 26 00 00, Basic Electrical Requirements, and Division 01 for submittal requirement.
- B. Submit manufacturer's literature and specification data sheets for each type of basic material, which is applicable to the project.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- A. Provide factory-wrapped waterproof flexible barrier material for covering materials, where applicable, to protect against physical damage in transit. Damaged materials shall be removed from project site.
- B. In their factory-furnished coverings, store materials in a clean, dry indoor space, which provides protection against the weather.

### **PART 2 - PRODUCTS**

#### **2.1 PENETRATION SEALING SYSTEMS (FIRE STOPS)**

- A. Provide penetration sealing where conduit, cable tray, etc. pass through rated walls, ceilings, and floors. See Section 07840, Fire Stopping, and Section 07900, Joint Sealants, for sealing requirements and systems.

#### **2.2 UL LISTING**

- A. All equipment and materials shall be new and conform to the requirements of this Section. All equipment and materials shall be UL listed, and shall bear their label whenever standards have been established and level service is regularly furnished. All equipment and materials shall be of the best grade of their respective kind for the purpose.

### **PART 3 - EXECUTION**

#### **3.1 ERECTION OF EQUIPMENT**

- A. Manufacturer's Installation Instructions: Where furnished or called for by the manufacturer equipment manufacturer's installation instructions shall be considered a part of this specification and fully complied with. Where the Contractor damages the finishing coat of paint in existing or completed areas, he shall refinish with matching paint.
- B. Mounting Heights: Individual safety switches and buttons and devices shall normally be installed at the following mounting heights, when not specified on the Drawings.
  - 3. Control Panels: 6 feet 0 inches (to top).
- C. Mounting: Equipment and control devices shall be supported independent of conduit connections. Panels or cabinets shall be mounted on metal frame supports independent of equipment. Control devices and metal enclosures shall be bolted or welded to steel channel or steel plate. All electrical equipment and devices not covered by the above, such as miscellaneous switches, thermostats, duct switches, temperature switches, floats, photoelectrical devices, and similar electrical devices shall be located and set as suitable for the application. Where control panels are provided as part of the equipment racks mounted on the floor, they shall be provided to support conduits and flexible connections to control panels.

### **3.2 COORDINATION**

- A. Exact location of all electrical equipment, devices and fixtures shall be determined in field by contractor and verified by Engineer's field representative prior to installation.

#### **END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

This Page is Intentionally Blank



## SECTION 26 05 19

### CABLE, WIRE AND CONNECTORS, 600 VOLT

#### PART 1 - GENERAL

##### 1.1 WORK INCLUDED

- A. Building wire.
  - 1. Control system circuitry.
  - 2. Lighting circuitry.
  - 3. Other systems circuitry as designated.
- B. Cable.
- C. Wiring connections and terminations.
- D. Electrical/control portion of HVAC work covered by Division 23 pertaining to 600 volt cable, wire and connectors shall follow the requirements set forth by this specification.

##### 1.2 REFERENCES

- A. NEMA WC 5 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- B. ANSI/UL 83 – Thermoplastic-Insulated Wire and Cables
- C. NFPA 70 – National Electrical Code, latest edition
- D. NEFA – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- E. Where application of National Electrical Code, trade association standards or publications appears to be in conflict with the requirements of this Section, the Architect/Engineer shall be asked for an interpretation.

##### 1.3 SUBMITTALS

- A. Provide submittals in accordance with and in addition to Section 26 00 00, Basic Electrical Requirements, and Division 01 for submittal requirements.
- B. Submit manufacturer's literature and specification data sheets for each item of cable, wire and connectors.
- C. Qualification of cable and wire manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years experience.

##### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Provide factory-wrapped waterproof flexible barrier material for covering wire and cable wood reels, where applicable; and weather resistant fiberboard containers for factory packaging of cable, wire and connectors, to protect against physical damage in transit. Damaged cable, wire or connectors shall be removed from project site.
- B. Store cable, wire and connectors in a clean, dry indoor space in their factory-furnished coverings, which provides protection against the weather.

#### PART 2 - PRODUCTS

##### 2.1 GENERAL REQUIREMENTS

- A. Generally, cable, wire and connectors shall be of manufacturer's standard materials, as indicated by published product information.

- B. Provide factory-fabricated wire of the size, rating, material and type as indicated for each service. Where not indicated, provide proper selection as required to comply with installation requirements and with NEC standards. The minimum size wire to be used for power or lighting circuits shall be #12 copper with insulation as noted below. Minimum size for control shall be #14 copper.
- C. The conductors of wires and cables shall be of copper (tinned where specified), and have conductivity in accordance with the standardization rules of the IEEE. The conductor and each strand shall be round and free of kinks and defects.
- D. Grounding conductors, where insulated, shall be colored solid green or identified with green color as required by the NEC. Conductors intended as a neutral shall be colored solid white, or identified as required by the NEC. All motor or equipment power wiring shall be colored according to Section 26 05 53, Electrical Identification.
- E. Use crimp type compression lugs for all wiring termination's, except on breakers or terminal strips in panel boards.

## **2.2 BUILDING WIRE**

- A. Thermoplastic-insulated Building Wire: NEMA WC 5.
- B. Rubber-insulated Building Wire: NEMA WC 3.
- C. Feeders and Branch Circuits, all sizes: 98% conductivity copper, soft-drawn, stranded conductor, 600 volt insulation, THHN/THWN-2 Use XHHW-2 conductors where installed in conduit underground. Use of aluminum conductors is acceptable for conductors #1/0 and above. All conductor sizes shown on plans are based on copper cable. If aluminum conductor is selected, the contractor is responsible for sizing the conductor to match or exceed the equivalent capacity of the copper conductor. Conduit size shall also be adjusted to suit the aluminum conductors.

## **2.3 REMOTE CONTROL AND SIGNAL CABLE**

- A. 600 Volt Insulation Control Cable for Class 1 Remote Control and Signal Circuits, Type TC:
  - 1. Individual Conductors: 14 AWG, stranded copper, XHHW insulation. Rated 90 degrees C dry, 75 degrees C wet, color-coded per ICEA Method 1 plus one green equipment grounding conductor.
  - 2. Assembly: Bundle wrapped with cable tape and covered with an overall PVC jacket. Cable shall pass IEEE-1202 vertical tray ribbon-burner flame test (210,000 BTU) VW-1.
- B. Instrumentation Cable
  - 1. 300 Volt Instrumentation Cable, Multiple Pairs, Overall Shield, Type PLTC:
    - a. Individual Conductors: 18 AWG, stranded, tinned copper, flame retardant polyethylene or PVC insulated, rated 105 degrees C, black and white numerically printed and coded pairs.
    - b. Assembly: Individual twisted pairs having a 100 percent coverage aluminum-polyester shield and 20 AWG stranded tinned copper drain wire. Conductor bundle shall be shielded with 100 percent coverage overall aluminum-polyester shield complete with 20 AWG drain wire. All group shields completely isolated from each other. Bundle wrapped with cable tape and covered with an overall flame retardant PVC jacket. Cable shall pass IEEE-383 vertical tray flame test (70,000 BTU) UL1581.
- C. Life Safety Systems Cable
  - 1. All life safety system wiring shall be installed in dedicated conduit or raceway with adequate separation/shielding from all other systems.
  - 2. Life safety systems wiring shall be as specified in the Section 28 31 00 - Fire Alarm and Smoke Detection Systems.

D. Security/Access Control/CCTV Cable

1. All security/access control wiring shall be installed in dedicated conduits.
2. Security/access control wiring shall be rated and as specified below:

Circuit Type	No. of Conductors	Conductor Specifications	Cable Specifications
20 mA Current Loop	2	18-gauge, stranded copper	2 cables, 1 twisted pair each required
Card Reader Coaxial	--	18-gauge, solid copper, center conductor	Schlage Model No. SE9284PL or Anicom 5910PL
Contact Circuits	2	18-gauge, stranded copper	Nonshielded, twisted
CCTV Coaxial	--	--	Belden 89259 plenum rated, or approved equal

3. All security/access control power circuit wiring shall comply with paragraph 2.2. Building Wire of this Section.

D. Plenum Cable for Class 3 Remote Control and Signal Circuits: 98% conductivity copper conductor, 300 volt insulation, rated 60 degree C, UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

**2.4 WIRING CONNECTIONS AND TERMINATIONS**

- A. Provide factory-fabricated, metal connectors of the size, rating, material, type and class as indicated for each service. Where not indicated, provide proper selection as required to comply with installation requirements and with NEC standards. Select from only following types, classes, kinds and styles.
  1. Type:
    - a. Solderless pressure connectors
    - b. Crimp.
    - c. Threaded.
    - d. Insulated spring wire connectors with plastic caps for 10 AWG and smaller.
  2. Class: Insulated.
  3. Material: Copper (for CU to CU connection).
  4. Style:
    - a. Insulated terminals. Use ring-terminal for control wiring. Use flange (fork) spade compression terminal for termination of stranded conductors at wiring devices, including ground connection.
    - b. Split bolt-parallel connector.
    - c. Pigtail connector.
    - d. Pre-insulated multi-tap connector.

## **PART 3 - EXECUTION**

### **3.1 INSPECTION**

- A. Installer must examine the areas and conditions under which cable, wire and connectors are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Inspect wire and cable for physical damage. Do not proceed with the work until unsatisfactory conditions have been corrected.

### **3.2 GENERAL WIRING METHODS**

- A. Install electrical cable, wire and connectors as indicated, in accordance with the manufacturer's written instructions, the applicable requirements of NEC and the National Electrical Contractors Association's "Standard of Installation", and as required to ensure that products serve the intended functions.
- B. Coordinate cable and wire installation work with electrical raceway and equipment installation work, as necessary for proper interface. Do not install the conductors until raceway system is complete and properly cleaned.
- C. Cables shall be selected on the basis of their purpose and UL listing. Generally, use Types THWN-2 and THHN-2 in building interiors and other dry locations. Outdoors and underground in raceways, use Type XHHW-2. Conductors subject to abrasion, such as in lighting poles, shall be Type XHHW-2.
- D. No conductor smaller than No. 12 wire shall be used for lighting purposes. In the case of "home runs" over 50' in length (100' for 277 volt) no conductor smaller than a No. 10 wire shall be used. The sizing of all wire except remote control wire shall be accomplished in the case of both feeder and branch circuits by conforming to the following provisions. Separate neutral conductors shall be provided for each phase of the same size for 120V/277V single-phase application for heavy electrical loads, computer loads, loads fed from isolated transformers, lab equipment, clinic equipment, dedicated circuits, unless noted otherwise on drawings. Voltage drop on feeders and branch circuits shall not exceed NEC requirement.
- E. Remote control wires shall be no smaller than No. 14 conductors. Control wires shall be run in separate conduits. Departures from the sizes so determined shall be made only in those cases in which the National Electrical Code requires the use of larger conductors. The sizes as determined from these tables shall be regarded as the acceptable minimum under all other circumstances. In no case, however, shall there be a voltage drop greater than that specified in any feeder or branch circuit. The Contractor may, if he deems it necessary or advisable, use larger sized conductors than those shown. Under no circumstances, however, shall the Contractor use any conductors sized in a manner which does not conform to the above mentioned tables without having first secured the written approval of the Owner's duly authorized representative.
- F. Splice branch circuits only in accessible junction or outlet boxes. Control cable shall never be spliced except the final connection to field devices. Where terminations of cables that are installed under this Section are to be made by others, provide pigtail of adequate length for neat, trained and bundles connections, minimum 5 feet at each location, unless noted otherwise on drawings.
- G. Wiring Within An Enclosure: Contractor shall bundle ac and dc wiring separately within an enclosure. The Contractor shall utilize panel wire-ways when they are provided. Where wireways are not provided the Contractor shall neatly tag, bundle wires and secure to sub-panel at a minimum of every three inches with T&B Type TC5355 heavy duty mounting bases.
- H. Do not band any conductor either permanently or temporarily during installation to radii less than four times the outer diameter of 600-volt insulated conductors.

### **3.3 WIRING INSTALLATION IN RACEWAYS**

- A. Wire and cable shall be pulled into clean dry conduit. Do not exceed manufacturer's recommended values for maximum pulling tension.
- B. Pull conductors together where more than one is being installed in a raceway.
- C. Use UL listed pulling compound or lubricant, when necessary; compound must not deteriorate conductor and insulation.
- D. Do not use a pulling means, including fish tape, cable or rope, which can damage the raceway.
- E. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
- F. Place an equal number of conductors for each phase of a circuit in same raceway.
- G. Provide separate conduit or raceway for line and load conductors of motor starters, safety disconnect switches, and similar devices. Those devices shall not share the same raceway.
- H. All conduits shall contain a green grounding conductor. Conduit, wireways, or boxes shall not be used as the equipment grounding conductor.

### **3.4 CABLE INSTALLATION**

- A. Provide protection for exposed cables where subject to damage during construction. Do not install cable before the completion of raceway system.
- B. Cable above ceilings shall be in conduit or raceways. Cables, conduits and raceways shall not be laid on ceiling tiles or strapped to ceiling wire.
- C. Use suitable cable fittings and connectors.
- D. It shall be the Contractor's responsibility to accurately measure all cable runs before the cable is cut. The Contractor shall furnish all tools and equipment, have sufficient properly trained personnel and shall exercise necessary care to ensure that the cable is not damaged during installation. Cable found to be damaged before installation shall not be installed. Cable damage during installation shall be removed and replaced. Repairs to cables can only be done with written permission from the Owner's Representative and only under special circumstances.
- E. Care shall be exercised with cables entering or leaving cable trays that all cable bend radii shall not be less than the recommended minimum and that cables are not left to rest unprotected on any sharp edge or corner.
- F. PVC jacketed cable shall not be installed or worked in any way at temperatures below 32 degrees F, unless cable has been previously stored in a heated area 48 hours prior to being pulled and transported to a heated pulling area.
- G. Each cable entering an enclosure shall have its conductors bundled together and identified with the cable number. All groups of conductors within an enclosure shall be shaped and formed to provide a neat appearance to facilitate future additions or rework. All control conductors shall be numbered and shall be labeled at each termination with this number, using markers designed for the application.
- H. Multi-Conductor Cable Installation: Fire alarm cable shall be routed in a separate conduit only.
- I. Instrument Cable: Instrument cable shall, when conduit installation is required be installed in rigid steel conduit. They shall not be spliced at any point. The shields and drain wires of shielded signal cables shall be grounded only at one point as indicated on the Drawings.

### **3.5 WIRING CONNECTIONS AND TERMINATIONS**

- A. Install splices, taps and terminations, which have equivalent-or-better mechanical strength and insulation as the conductor. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

- B. Keep conductor splices and taps accessible and to a minimum, and in junction boxes only. Control circuit conductors shall terminate at terminal blocks only. Splices below grade shall only be in handholes or manholes and shall be made watertight with epoxy resin type splicing kits similar to Scotchcast.
- C. Use splice, tap and termination connectors, which are compatible with the conductor material.
- D. Thoroughly clean wires before installing lugs and connectors.
- E. Terminate spare conductors with electrical tape and label as spare.
- F. Power and Lighting Circuits: Use solderless pressure connectors with insulating covers for copper wire splices and taps, 8 AWG and larger. For 10 AWG and smaller, use insulated spring wire connectors with plastic caps on lighting and receptacle circuits.
- G. Use split bolt connectors for copper wire splices and taps, 6 AWG and larger. Tape un-insulated conductors and connectors with electrical tape to 150 percent of the insulation value of conductor.
- H. Connections for all wire sizes in motor terminal boxes where the motor leads are furnished with crimped-on lugs shall be made by installing ring type compression terminals on the motor branch circuit ends and then bolting the proper pairs of lugs together. First one layer of No. 33 scotch tape reversed (sticky side out), then a layer of rubber tape, then two layers of No. 33 half-lapped.
- I. Identify conductors per Section 26 05 53 - Electrical Identification.

### **3.6 FIELD QUALITY CONTROL**

- A. Torque test conductor connections and terminations to manufacturer's recommended values.
- B. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.
- C. Conductors in vertical conduits or raceways shall be supported in the manner set forth in the appropriate section of the latest revision of the National Electrical Code. Lighting fixtures shall not be used for raceways for circuits other than parallel wiring of fixtures.
- D. Conductors may be run in parallel on sizes 1/0 to 500 MCM inclusive provided all paralleled conductors are the same size, length, and type of insulation. Except as otherwise shown on drawings, no more than three conductors may be run in parallel, and they shall be so arranged and terminated as to insure equal division of the total current between all conductors involved. Where parallel connection is contemplated, approval of the Owner's representative must be obtained before installation is made.

### **3.7 TESTING AND ACCEPTANCE**

- A. Before final acceptance, the Contractor shall make voltage, insulation, and load tests, necessary to demonstrate to the Owner's representative the satisfactory installation and proper performance of all circuits.
- B. Test feeder conductors clear of faults. Insulation-resistance test shall be conducted per NETA – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems. Test results below 50 megohms shall be cause for rejection of the wiring installation. Replace and retest all such rejected conductor.
- C. At the completion of this project, the Contractor shall provide for the Owner three (3) complete and finally corrected sets of working drawings. These sets of working drawings shall be new, unused and in good condition, and shall include the nature, destination, path, size and type of wire and all other characteristics for complete identification of each and every conduit and circuit.

#### **END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

## SECTION 26 05 26

### GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS:

- A. The Conditions of the Contract and applicable requirements of Divisions 0 and 1 and Section 26 00 01, "Electrical General Provisions", govern this Section.

##### 1.2 DESCRIPTION OF WORK:

- A. Work Included: Provide electrical service, distribution, and equipment grounding as shown, scheduled, indicated, and as specified.
- B. Types: The types of electrical distribution and equipment grounding specified in this Section include, but are not necessarily limited to, grounding all equipment and devices shown and as required by the National Electrical Code (NEC), the local electrical inspection department, and The Power Company.

##### 1.3 STANDARDS:

- A. Products shall be designed, manufactured, tested, and installed in compliance with the following Standards:
  - 1. ANSI/IEEE Standard 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
  - 2. ANSI/UL 467 - Safety Standard for Grounding and Bonding Equipment.
  - 3. NFPA 70 - National Electrical Code (NEC).

##### 1.4 QUALITY ASSURANCE:

- A. NEC Compliance: Comply with Article 250 of the NEC for grounding.
- B. Approval: All grounding shall be in accordance with the requirements of, and shall be subject to the approval of the Engineer and the local electrical inspection department.
- C. UL Label: All grounding products shall be UL-labeled.
- D. Manufacturers: Provide grounding products complying with these specifications and as manufactured by Copperweld and Cadweld.

##### 1.5 SUBMITTALS:

- A. Shop Drawing submittals shall include, but not be limited to, the following:
  - 1. A complete grounding system diagram for special grounding systems.
  - 2. Cut sheets of grounding products.
  - 3. Additional information as required in Section 26 00 01, "Electrical General Provisions"..

## 1.6 STORAGE AND HANDLING:

- A. Store grounding products in a clean, dry space.

## PART 2 - PRODUCTS

### 2.1 MATERIALS AND COMPONENTS:

- A. General: For each electrical grounding connection, provide a complete assembly of materials to construct a completely grounded electrical system.
- B. Raceways: Raceways for grounding conductors shall be as specified in Section 26 05 33 "Electrical Raceways", and Section 26 05 34, "Electrical Boxes".
- C. Cable, Wire, and Connectors: Grounding cable, wire and connectors shall be as specified in Section 26 05 19, "Low Voltage Conductors and Cables".
- D. Ground Clamps: Ground clamps for connecting grounding conductors to copper, brass, or lead pipes shall be made of copper and if pipes are of steel or iron, the ground clamps should be made of galvanized iron. These clamps shall be designed to provide permanent and positive pressure and to avoid mechanical injury to the pipe. Use exothermic welds for connecting ground wires to ground rods, for all below grade counterpoise ground grids, and elsewhere where noted on the Drawings.
- E. Ground Conductors and Jumpers: Grounding conductors and jumpers shall be connected to each other and to items to be grounded by means of approved type pressure connectors, clamps and other suitable methods approved by the Engineer. No solder connections shall be made.
- F. Ground Buses: Ground buses shall be 1/4" x 4" minimum copper ground buses with mounting brackets and insulators. Power ground buses shall be pre-drilled with three rows of lug bolt holes and telecom ground buses shall be pre-drilled with four rows of lug bolt holes. Bus length shall be adequate for installing lugs for all conductors shown on the drawings/required plus 25% spare lug bolt holes and shall be minimum 12" long.
- G. Exothermic Welds: Use cadweld or an approved equal system of exothermic welding for welded grounding connections where shown on the Drawings or specified.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF ELECTRICAL GROUNDING:

- A. General: Install grounding connections as shown and specified, in accordance with applicable portions of the NECA's "Standard of Installation", and recognized industry practices to ensure that products serve the intended functions.
- B. Grounding Electrode System and Building Ground Riser/Buses: This is an existing Base Building system.
- C. Bonding: All new metallic piping systems and building steel shall be effectively bonded to the electrical grounding system in accordance with Article 250 of the NEC. Install bonding jumpers to all piping systems and building steel.
- D. Building Equipment Grounding System: The building equipment grounding system shall consist of the ground wire and electrically continuous metallic conduit system as shown. Every item of equipment served by the electrical system shall be bonded to the building equipment ground. Portions of metallic piping and duct systems which are electrically isolated shall be bonded to the equipment grounding system with a flexible bonding jumper.



- E. System Neutral: The neutral of separately derived systems shall be grounded at one point as specified hereinbelow.
- F. Miscellaneous: Provide bonding and grounding wires run in conduit and sized per the NEC in accordance with the local electrical inspection department and the NEC. Metallic piping and duct systems which enter the building shall be grounded at the point of entry to the building, in accordance with the NEC. Provide grounding of the raised floor systems as shown or detailed on the drawings.
- G. Continuity: Continuity of the building equipment grounding system shall be maintained throughout the project. Grounding jumpers shall be installed across conduit expansion fittings, all liquidtight flexible metal and flexible metal conduit, light fixture pigtails in excess of 6', and all other non-electrically continuous raceway fittings.
- H. Main Conductors: All main grounding conductors shall be stranded copper conductors, sized as shown or per the NEC, and run in a suitable raceway. All main grounding conductors shall be continuous without joints or splices over their entire length.
- I. Special Grounding: Provide special grounding systems where shown on the Drawings.
- J. Separately Derived System Grounding: Bond the case and neutral of each transformer directly to the base building grounding system ground bus on the floor. Flexible conduit shall not be used as a ground path to a transformer.
- K. Voice/Data Equipment Grounding: Provide a ground conductor from voice/data terminal provisions to the building grounding system as required by the local Telephone Company and as shown on the drawings.
- L. Light Fixtures: Carefully and securely ground all LED and fluorescent fixture bodies to the conduit grounding system. Flexible conduit longer than 6' shall not be considered a ground path.
- M. Receptacles: Ground all grounding type receptacles with a separate ground wire, where present in the branch circuit. Further, ground each outlet by the use of an approved grounding clip attached to the junction box in such a position to be readily inspected on removal of the coverplate; or by the use of an approved grounding yoke type receptacle.
- N. Isolated Ground Receptacles: Where isolated ground receptacles are shown on the Drawings, ground each isolated ground receptacle with a separate insulated ground wire; this ground wire shall not be connected to the outlet box. Ground each isolated ground receptacle outlet box with a separate grounding conductor unless a metal raceway is to be used and effectively grounds the outlet box.
- O. Motor Frames: Ground the frame of each motor with a properly sized separate ground wire around the liquidtight flexible conduit.
- P. Rigid Nonmetallic Conduit Systems: Install a continuous grounding conductor in accordance with NEC.
- Q. Feeder and Branch Circuits: Provide a separate, insulated equipment grounding conductor in each feeder or branch circuit. Terminate each end on a grounding lug, bus, or bushing.
- R. Bolted Connections: Connections requiring bolting shall be made up with Monel metal bolts, washers, and nuts. Connections shall be made only after surfaces have been cleaned, or ground to expose virgin metal. No strap grounding clamps shall be used.
- S. Power Feeders: Ground the raceway and ground conductors in 600 volt power feeders in accordance with the NEC. Bond all pull boxes and splice boxes in accordance with the NEC.
- T. Branch Circuits: Install an insulated ground wire, sized per the NEC, in all branch circuits.

3.2 **COORDINATION:**

- A. General: Coordinate installation of grounding connections for equipment with equipment installation work. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Connections: Use exothermic welds for connecting bonding and grounding conductors to ground rods, to counterpoise, structural steel, piping systems, and elsewhere where shown on the Drawings. Provide all accessories required for a complete installation.

**END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

## SECTION 26 05 29

### SECURING AND SUPPORTING METHODS

#### PART 1 - GENERAL

##### 1.1 WORK INCLUDED

- A. Raceway, cable tray, and equipment supports
- B. Fastening hardware
- C. Coordinate location of concrete equipment pads

##### 1.2 QUALITY ASSURANCE

- A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry. Support systems shall be sized adequately to support an additional 25% for future loads

##### 1.3 COORDINATION

- A. Coordinate with other trades where conduit and cable tray supports are in the same location as piping, ductwork, and work of other trades and where supports are furnished and installed under other Divisions. Supporting from the work or supports of other Contractors shall not be allowed except by express, written permission of the Owner.

##### 1.4 SUBMITTALS

- A. Provide submittals in accordance with and in addition to Section 26 00 00, Basic Electrical Requirements, and Division 01 for submittal requirement.

#### PART 2 - PRODUCTS

##### 2.1 MATERIAL

- A. Support Channel:
  - 1. All non-corrosive locations: Hot-dip galvanized steel.
  - 2. Corrosive locations: Nonmetallic fiberglass.
- B. Hardware:
  - 1. All non-corrosive locations: Hot-dip galvanized steel.
  - 2. Corrosive locations: Stainless steel threaded rod, attachments and fasteners shall be used with fiberglass supports.
- C. Threaded Rod: used for rack support from structure above; 3/8-inch minimum diameter.

#### PART 3 - EXECUTION

##### 3.1 INSTALLATION

- A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using precast insert system, expansion anchors, or beam clamps. Do not use spring steel clips and clamps. Provide necessary calculations to select proper support materials for electrical equipment, raceway, and cable tray supports. Provide cable tray supports for cable tray filled to 125 percent capacity per NEC.
- B. Install hangers, anchors, sleeves and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to insure supporting devices comply with requirements. Comply with requirements of NEC for installation of supporting devices. Install supports with spacing in compliance with NEC requirements.

- C. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors in solid masonry walls; or concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.
- D. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.
- E. Do not use powder actuated anchors without written permission from the Engineer.
- F. Do not drill structural steel members without written permission from the Structural Engineer.
- G. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.
- H. Bridge studs top and bottom with channels to support recessed mounted cabinets and panelboards in stud walls.
- I. Install surface mounted cabinets and panelboards with a minimum of four anchors. Provide strut channel supports to stand cabinet 1-5/8 inches off wall. Utilize "Post Bases" where support channel is attached to structural floor.
- J. Provide extra care in supporting PVC conduit to protect it from potential damage.
- K. Use fiberglass for nonmetallic raceway systems supports in areas subject to corrosives.
- L. All supports in contact with floor using stanchion type support shall be solidly bolted to the permanent structural floor.
- M. Conduit supports shall have at a minimum, the bottom support member constructed of double strut. This horizontal member shall be double-nutted, and the supporting all-thread rod shall be trimmed to one inch below lowest nut.
- N. Conduit entering/exiting cable tray shall be attached to the tray rail by means of unistrut bolted to the rail and standard manufacturer's accessories. Conduit shall only enter/exit tray horizontally supported within three feet of the tray, and extended into the tray two inches. Conduit shall be terminated with a grounding bushing, and bonded to the tray ground wire. (The attachment to the tray shall not be considered a support.)
- O. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.
- P. Install freestanding electrical equipment on 4-inch concrete pads. Pad shall be a minimum four inches larger than equipment. No crevices shall be left around the pads. Equipment includes but not limited to the following:
  - 1. Motor Control Centers
  - 2. Static Transfer Switches
  - 3. Floor mounted VFDs
  - 4. Floor mounted transformers
  - 5. Switchboards, 1200A and larger
- Q. Do not anchor supports to columns. Where panelboards, cables, or conduits are routed on the face of a column provide "column hugging" channel supports.

### **3.2 TOUCH-UP**

- A. Touch-up all scratches on securing and supporting system, and paint the ends of channel after cutting with an approved zinc chromate or 90 percent zinc paint.

END OF SECTION

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

## SECTION 26 05 33

### RACEWAYS, CONDUITS AND BOXES

#### PART 1 - GENERAL

##### 1.1 WORK INCLUDED

- A. Raceways:
  - 1. Wireways.
- B. Conduit:
  - 1. Rigid metal conduit and fittings. (RGS)
  - 2. Intermediate metal conduit and fittings. (IMC)
  - 3. Electrical metallic tubing and fittings. (EMT)
  - 4. Flexible metal conduit and fittings.
  - 5. Liquid-tight flexible metal conduit and fittings.
  - 6. Non-metallic conduit and fittings. (underground use only)
  - 7. PVC coated rigid steel conduit.
- C. Boxes:
  - 1. Wall and ceiling outlet boxes.
  - 2. Pull and junction boxes.
- D. Electrical/control portion of HVAC work covered by Division 23 pertaining raceway, conduit and boxes shall follow the requirement set forth by this specification.

##### 1.2 REFERENCES

- A. NFPA 70 – National Electrical Code, latest edition
- B. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated
- C. ANSI C80.3 - Electrical Metallic Tubing, Zinc-Coated
- B. ANSI/NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies
- E. EMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing
- F. ANSI/NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
- H. ANSI/NEMA TC 2 – Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
- I. ANSI/UL 1 – Flexible Metal Conduit
- J. ANSI/UL 5 – Surface Metal Raceways and Fittings
- K. ANSI/UL 360 – Liquid-tight Flexible Steel Conduit
- L. ANSI/UL 467 – Electrical Grounding and Bonding Equipment
- M. ANSI/UL 651 – Schedule 40 and 80 Rigid PVC Conduit (underground use only)
- N. ANSI/UL 797 – Electrical Metal Tubing
- O. ANSI/UL 870 – Wireways, Auxiliary Gutters and Fittings

- P. NEMA RN 1 – Polyvinyl Chloride (PVC) Externally Coated galvanized Rigid Steel Conduit and Intermediate Metal Conduit
- Q. NEMA VE 1 – Metallic Cable Tray Systems
- R. UL 6 – Rigid Metal Conduit
- S. ANSI/UL 5C – Surface Raceways and Fittings for Use with Data, Signal, and Control Circuits
- T. ANSI/UL 498 – Attachment Plugs and Receptacles
- U. ANSI/UL 943 – Ground Fault Circuit Interrupters

### **1.3 SUBMITTALS**

- A. Provide submittals in accordance with and in addition to Section 26 00 00, Basic Electrical Requirements, and Section 01330, Submittal Procedures.
- B. Shop drawings consisting of a complete list of equipment and materials, which will be used for the project, including manufacturer's descriptive and technical literature, catalog cuts and installation instructions.
- C. Sealing/fire stopping materials and details.

### **1.4 STORAGE AND HANDLING**

- A. Handle materials carefully to avoid damage, breaking, denting and scoring. Damaged equipment or materials shall not be installed.
- B. Store materials in a clean dry space and protected from the weather.

## **PART 2 - PRODUCTS**

### **2.1 WIREWAYS**

- A. Wireways shall be of steel construction general purpose for indoor spaces and rain tight for outdoor applications with knockouts.
- B. Size shall be as indicated on Drawings.
- C. Cover shall be hinged or screw applied as indicated on Drawings. Rain tight wireways shall be provided with full gasketing.
- D. Fittings shall be so constructed to continue the "lay-in" feature through the entire installation.
- E. Provide all sheet metal parts with a rust inhibiting phosphating primer coating and finished in gray enamel. All hardware shall be cadmium plated to prevent corrosion.

### **2.2 CONDUIT AND FITTINGS**

- A. Conduit and fittings for all electrical systems on this project shall include the following:
  - 1. Electrical power and lighting feeders
  - 2. Electrical power and lighting circuits
  - 3. Other electrical systems
- B. For each electrical wireway system indicated, provide a complete assembly of conduit, tubing or duct with fittings including, but not necessarily limited to, connectors, nipples, couplings, locknuts, bushings, expansion fittings, other components and accessories as needed to form a complete system of the same type indicated.
- C. Conduit fittings shall be designed and approved for the specific use intended. Conduit fittings, including flexible, shall have insulated throats or bushings. Rigid conduits shall have insulated bushings, unless grounding bushings are required by N.E.C. Article 250. Grounding bushings shall have insulated throats.
- D. Rigid and intermediate metal conduit shall be hot-dipped galvanized. Fittings shall be threaded

type. Expansion fittings shall be OZ Type DX.

- E. Electrical metallic tubing shall be galvanized. Fittings shall be all steel compression type. Expansion fittings shall be OZ Type TX.
- F. Flexible metal conduit and fittings shall be zinc-coated steel.
- G. Liquid-tight flexible conduit and fittings shall consist of single strip, continuous, flexible interlocked, double-wrapped steel, galvanized inside and outside, forming smooth internal wiring channel with liquid-tight covering of flexible polyvinyl chloride (PVC). It shall be furnished with a sealing O-ring where entering an enclosure subject to moisture. Where O-Rings are used, ground type bushings shall be used in the box or enclosure.
- H. Nonmetallic conduit and fittings shall be suitable for temperature rating of conductor but not less than 90°C. Nonmetallic conduit and fittings shall be molded of high impact PVC compound having noncombustible, nonmagnetic, non-corrosive and chemical resistant properties and shall be of the same manufacturer. Where located outdoors and above ground, the conduit and fittings shall be UV resistant. Solvent cement shall be of the same manufacturer as the conduit and shall be of the brush-on type. Spray solvents are prohibited. PVC coated metallic fittings shall not be permitted for PVC conduit connections.
- I. Crimp or set-screw type fittings are not acceptable.
- J. Minimum conduit size shall be 3/4 inch, except 1/2 inch flexible metallic conduit may be used as fixture whips.
- K. PVC coated rigid steel conduit shall be externally coated with a 40 mil PVC coating and internal phenolic coating over a galvanized surface.

### **2.3 PULL AND JUNCTION BOXES**

- A. Boxes shall be galvanized sheet metal conforming to ANSI/NEMA OS 1 with screw-on cover and welded seams, stainless steel nuts, bolts, screws and washers.
- B. Boxes larger than 12 inches in any dimension shall be panelboard code gauge galvanized steel with hinged cover.
- C. Boxes shall be sized in accordance with NEC.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION - CONDUIT**

- A. Install products as indicated, in accordance with the applicable requirements of NEC, NEMA and the National Electrical Contractors Association's "Standard of Installation".
- B. Cut conduit square using a saw or pipe cutter. De-burr cut ends. Joints in steel conduit must be painted with T&B Kopr shield and drawn up tight. Threads for rigid metal conduit and IMC shall be deep and clean. Running threads shall not be used. Wipe plastic conduit clean and dry before joining. Apply full, even coat of cement with brush to entire area that will be inserted into fitting. Let joint cure for 20 minutes minimum. Spray type of cement is not acceptable. Install raceway and conduit system from point of origin in outlets shown, complete with support assemblies including all necessary hangers, beam clamps, hanger rods, turnbuckles, bracing, rolls, clips angles, through bolts, brackets, saddles, nuts, bolts, washers, offsets, pull boxes, junction boxes and fittings to ensure a complete functional raceway system. Where vertical drops of conduit are made to equipment in open space, the vertical conduit shall be rigidly supported from racks supported on the floor.
- C. Install rigid wall hot-dipped galvanized steel conduit or hot-dipped galvanized intermediate metal conduit for service entrance; feeders; wall or floor penetrations; mechanical rooms electrical rooms and exposed locations where there is a high potential subject to physical damage; exposed outdoor locations; damp locations or any location as per design drawing. The following exceptions permitted:

1. EMT
  - a. In sizes up to and including 1-1/2 inch, may be used inside dry locations where not subject to mechanical damage. EMT may be used in air-conditioned spaces, such as accessible ceilings, dry wall partitions and exposed where 6 feet above the floor. EMT may not be used outside, in concrete, underground, in under floor spaces, in masonry walls, in locations likely to be damp, in electrical rooms subject to mechanical damage due to future installation, or exposed within 6 feet of the floor. EMT shall not be used for medium voltage circuits.
  - b. Where used for feeder circuits receptacle branch circuits and motor branch circuits EMT shall also contain a NEC grounding conductor.
  - c. All conduits shall be concealed in walls or ceilings unless otherwise noted.
2. Liquid-tight
  - a. Install liquid-tight flexible metal conduit for connections to rotating, vibrating, moving or movable equipment, including dry-type transformers. Install external ground wire on flexible conduit with grounding bushings. Maximum length shall be 6 feet minimum of 2 feet.
3. Flexible Metal Conduit
  - a. Install standard flexible metal conduit (not liquid-tight), which shall be only used for lighting fixture whips or motor vibrations, with internal ground wire. Install flexible conduit connection such that vibrations are not transmitted to adjoining conduit or building structure. Maximum length shall be 6 feet minimum of 3 feet; minimum size shall be 3/4; and minimum size shall be 1/2 inch for lay-in light fixture whips.
- D. Install conduits parallel and supported on Unistrut, or equal, trapezes and anchored with split ring hangers, conduit straps or other devices specifically designed for the purpose. No raceways or boxes shall be supported using wire. Arrange conduit to maintain headroom and present a neat appearance. Conduit routes shall follow the contour of the surface it is routed on. Route exposed conduit and tray above accessible ceilings parallel and perpendicular to walls and adjacent piping. Maintain 12-inch clearance between conduit and heat sources, such as flues, steam pipes, and heating appliances. Wire ties or "wrap lock" are not permitted to support or secure conduit system. Fasten conduit with the following material:
  1. Wood screws on wood
  2. Toggle bolts on hollow masonry
  3. Bolts and expansion anchors in concrete or brick
  4. Machine screws, threaded rods and clamps on steel
  5. Conduit clips on steel joists.
  6. 4 inch x 4 inch penta-treated pine installed in pitch pans on roof, spaced at intervals not to exceed 5 feet.
- E. Install conduits outside of building lines at a minimum depth of 30 inches below finished grade. Maintain twelve inches earth or two inches concrete separation between electrical conduits and other services or utilities underground. Encase all plastic service entrance conduits with concrete unless otherwise specifically detailed or noted on the drawings.
- F. Fittings shall be approved for grounding purposes or shall be jumpered with copper grounding conductors of appropriate ampacity. Leave termination of such jumpers exposed.
- G. Install expansion fittings in metal and PVC conduit as follows:
  1. Conduit Crossing Building Expansion Joints:



- a. EMT all sizes
  - b. IMC all sizes
  - c. RMC all sizes
  - d. PVC all sizes
2. Conduits entering environmental rooms and other locations subject to thermal expansion and as required by NEC.
  3. Unless expansion fitting has an integral bonding braid, as in Crouse-Hinds Type XC, a green insulated grounding conductor shall be pulled in the conduit. Both ends of this green grounding conductor shall be accessible for inspection.
- H. Install conduit concealed in walls, partitions and above ceilings. Install conduit exposed in ceiling area (at structure) of boiler rooms, mechanical rooms and in other similar rooms where ceilings are not called for.
  - I. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.
  - J. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture if cable or wire are not installed immediate after conduit run. Tape covering conduit ends is not acceptable.
  - K. Provide 200 lb. nylon cord full length in empty conduit.
  - L. Where conduit penetrates fire-rated walls and floors, provide pipe sleeve two sizes larger than conduit; pack void around conduit with oakum and fill ends of sleeve with fire-resistive compound or provide mechanical fire-stop fittings with UL listed fire-rating or seal opening around conduit with UL listed foamed silicone elastomer compound equal to fire-rating of floor or wall.
  - M. Install no more than the equivalent of three 90-degree bends between boxes. Where four 90 degree bends are required, prior approval by the Engineer is required. Use conduit bodies to make sharp changes in direction, as around beams. Conduit bodies shall be readily accessible and sized for the cables installed. Running or rolling offsets are not approved. Use factory long radius elbows for bends in conduit larger than 2-inch size. All parallel bends shall be concentric.
  - N. Nylon pull string shall be provided full length in conduit designated for future use.

### **3.2 INSTALLATION - WIREWAYS**

- A. Bolt wireways to steel channels fastened to the wall or in self-supporting structure. Install level.
- B. Gasket each joint in oil-tight wireway.
- C. Mount rain tight wireway for exterior installation in horizontal position only.

### **3.3 INSTALLATION - BOXES**

- A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.
- B. Provide outlet box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes being used and meeting requirements of individual situations.
- C. Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify location of outlets prior to rough-in.
- D. Locate and install boxes to allow access, minimum 12 inches above ceiling except where space dimensions do not allow.
- E. Do not install boxes back-to-back in walls. Provide minimum 6-inch separation. Provide

minimum 24-inch separation in acoustic-rated walls. If boxes are connected together, install flexible connection between the two and pack openings with fiberglass.

- F. Secure boxes rigidly to the substrate upon which they are being mounted, or solidly imbed boxes in concrete or masonry. Do not support junction boxes from the raceway systems. Boxes shall not be permitted to move laterally. Boxes shall be secured between two studs. Boxes connected to one stud are not permitted.
- G. Provide knockout plugs for unused openings.
- H. Use multiple-gang boxes where more than one device is mounted together. Do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
- I. Install boxes in walls without damaging wall insulation.
- J. Outlet boxes in plaster partitions shall be "shallow-type" set flush in wall so there is at least 5/8 inch plaster covering back of box.
- K. Outlet boxes for switch shall not be used as junction boxes.
- L. Coordinate mounting heights and locations of outlets mounted above counters, benches and backsplashes.
- M. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.
- N. Outlet boxes supporting fixtures shall be securely anchored in place in an approved manner. Support outlet boxes and fixtures in acoustic ceiling areas from building structures, not from acoustic ceilings. Lighting fixture outlets shall be coordinated with mechanical and architectural equipment and elements to eliminate conflicts and provide a workable neat installation.
- O. Set floor boxes level and flush with finish flooring material.
- P. Provide tamper resistance receptacles in child care areas, psychiatric, and medical facilities.

### **3.4 WALL AND FLOOR PENETRATIONS:**

- A. Core drilling shall be approved in writing by the Structural Engineer prior to execution.
- C. Provide a 4 inch curb around block outs through concrete floors. Fire-stop all openings per Architectural specification.
- D. Route conduit through roof openings for piping and ductwork where possible; otherwise, route through roof jack with pitch pocket. Coordinate roof penetrations with the roofing contractor.

### **END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

## SECTION 26 05 53

### ELECTRICAL IDENTIFICATION

#### PART 1 - GENERAL

##### 1.1 WORK INCLUDED

- A. Nameplates and tape labels
- B. Wire and cable markers
- C. Conduit color coding and labeling

##### 1.2 REFERENCES

- A. NFPA 70 – National Electrical Code (latest edition)

##### 1.3 SUBMITTALS

- A. Provide submittals in accordance with and in addition to Section 26 00 00, Basic Electrical Requirements, and Division 01 for submittal requirement.
  - 1. Furnish nameplate identification schedules listing equipment type and nameplate data with letter sizes and nameplate material.

#### PART 2 - PRODUCTS

##### 2.1 MATERIALS

- A. Equipment Nameplates:
  - 1. For normal power electrical equipment, provide engraved three-layer laminated plastic nameplates, engraved white letters on a black background.
  - 2. For emergency equipment provide engraved three-layer laminated plastic nameplates with engraved white letters on a red background.
  - 3. For UPS powered equipment provide engraved three-layer laminated plastic nameplates with engraved white letters on an orange background.
  - 4. For fire alarm system provide engraved three-layer laminated plastic nameplates with white letters on a yellow background.
- C. Conductor Color Tape and Heat Shrink:
  - 1. Colored vinyl electrical tape shall be applied perpendicular to the long dimension of the cable or conductor.
  - 2. In applications utilizing tray cable, heat shrinkable tubing shall be used to obtain the proper color coding for the length of the conductor in the cabinet or enclosure. Variations to the cable color coding due to standard types of wire or cables are not acceptable.
- D. Conduit Labels (5 kV and 15 kV Conduits Only): 2-inch black letters on yellow background reading "DANGER - 12,470 VOLTS" or "DANGER - 4,160 VOLTS". Labels shall have adhesive backing, and shall be installed at intervals not exceeding 50 feet and on all pull boxes located to be visible from floor.
- E. Warning labels: Provide warning labels with black lettering on red background with a minimum of 1/2" lettering.
- F. Tape Labels: Embossed adhesive tape, with minimum 1/4-inch letters for labeling receptacles, switches, control device stations, junction and pull boxes and manual motor starter units, etc.
  - 1. White letters on black background for normal power.

- 2. White letters on red background for emergency/standby power.
- 3. White letters on orange background for UPS power.
- G. J-Box and Cover plate Voltage Labels: Black stenciled letters 1/4" high. Adhesive back tapes may be used if a clear tape is applied over the label for protection.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Degrease and clean surfaces to receive nameplates or tape labels.
- B. Install nameplates parallel to equipment lines.
- C. Secure plastic nameplates to equipment fronts using screws or rivets. Use of adhesives shall be per Owner's approval. Secure nameplate to outside face of flush mounted panelboard doors in finished locations.

**3.2 WIRE IDENTIFICATION**

- A. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits. Label control wire with number as indicated on schematic and interconnection diagrams or equipment manufacturer's shop drawings for control wiring.
- B. Conductors for power circuits to be identified per the following schedule.

Conductor	System Voltage		
	480/277V	208/120V	
Phase A	Brown	Black	
Phase B	Purple	Red	
Phase C	Yellow	Blue	
Neutral	Gray	White	
Grounding IG	Green N/A	Green Green w/Yellow	

**3.3 NAMEPLATE ENGRAVING SCHEDULE**

- A. Provide nameplates of minimum letter height as scheduled below. Nameplates shall be same as equipment names indicated on the Drawings.
- B. Individual Circuit Breakers in Distribution Panelboards, Disconnect Switches, Motor Starters, and Contactors: 1/4-inch; identify source to device and the load it serves, including location.
- C. Dry Type Transformers Not in Substations: 3/8-inch; identify equipment designation. 1/4-inch; identify primary and secondary voltages, primary source, and secondary load and location.
- D. Automatic Transfer Switches: 3/8-inch; white letters and red background; identify equipment designation 1/4-inch; identify voltage rating, normal source, standby source and load served including location.
- E. Panelboards: 3/8-inch; identify equipment designation. 1/4 -inch; identify source, voltage and bus rating.

**3.4 ENCLOSURE COLOR CODING**

- A. The following systems shall have each junction and pull box cover completely painted per the following:

System	Color of Box Cover
Telecommunications	Brown
DDC	Blue
Emergency Power	Red
Security	White
Fire Alarm	Yellow
UPS	Orange

**END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

This Page is Intentionally Blank

## SECTION 26 24 16

### PANELBOARDS

#### PART 1 - GENERAL

##### 1.1 WORK INCLUDED

- A. Distribution panelboards.
- B. Branch circuit panelboards.

##### 1.2 REFERENCES

- A. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
- B. NAME KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- C. NEMA PB 1 - Panelboards.
- D. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- E. NEMA PB 1.2 - Application Guide for Ground-fault Protective Devices for Equipment.
- F. NEMA AB 3 – Molded Case Breakers and Their Application
- G. ANSI/UL 67 – Electric Panelboards
- H. ANSI/UL 50 – Cabinets and Boxes
- I. ANSI/UL 508 – Industrial Control Equipment

##### 1.3 SUBMITTALS

- A. Provide submittals in accordance with and in additional to Section 26 00 00.UT, Basic Electrical Requirements, and Division 01 for submittal requirement.
- B. Submit dimensioned drawings showing size, circuit breaker arrangement and equipment ratings including, but not limited to, voltage, main bus ampacity, integrated short circuit ampere rating, and temperature rating of circuit breaker terminations.

##### 1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver distribution panelboards in factory-fabricated water-resistant wrapping.
- B. Handle panelboards carefully to avoid damage to material component, enclosure and finish.
- C. Store in a clean, dry space and protected from the weather.

#### PART 2 - PRODUCTS

##### 2.1 ACCEPTABLE MANUFACTURERS

- A. Square D Company
- B. General Electric Company
- C. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in 26 00 00.UT, and Division 01 for substitution requirement.

## 2.2 PANELBOARD CONSTRUCTION

- A. General: Provide flush or surface mounted, or surface mounted deadfront circuit breaker type distribution or branch circuit panelboards with electrical ratings and configurations, as indicated on the drawings and schedules. Load center type of panelboards are not acceptable.
- B. Enclosure:
1. Enclosure shall be proper NEMA type as shown on the drawings.
  2. NEMA 1
    - a. Back box shall be galvanized steel for flush mounted branch circuit panelboards. Back box shall have gray enamel electro-deposited finish over cleaned phosphatized steel for all other type panelboards.
    - b. Provide panelboard fronts with screw cover and hinged door with flush lock.
    - c. Where power monitors or metering are specified on the Drawings, the manufacturer shall cut the doors for field mounting of the unit.
  3. NEMA 3R, 3S and 12
    - a. Enclosure and doors shall have gray enamel electro-deposited finish over cleaned phosphatized steel.
    - b. Doors shall be gasketed and equipped with tumbler type vault lock and two trunk latches where required by UL standard. Interior trim shall consist of four pieces, each covering one gutter top, bottom and both sides.
  4. Construct cabinet in accordance with UL 50. Use not less than 16-gauge galvanized sheet steel, with all cut edge galvanized. Provide a minimum 4-inch gutter wiring space on each side. Provide large gutter where required to accommodate the size and quantity of conductors to be terminated in the panel, and where required by code.
  5. Exterior and interior steel surfaces shall be cleaned and finished with gray enamel over rust inhibiting phosphatized coating. Color shall be ANSI 61 gray.
  6. Doors shall be equipped with flush-type combination catch and key lock. All locks shall be keyed alike.
  7. Branch circuit panelboards shall be 5 ¾ inches deep.
  8. A directory holder with heavy plastic plate, metal frame, and index card shall be mounted inside of each door.
  9. Reinforce enclosure and securely support bus bars and overcurrent devices to prevent vibration and breakage in handling.
  10. Rating: Minimum integrated short-circuit rating, voltage and current rating as shown on drawings.
  11. Labeling: The Contractor shall furnish and install engraved, laminated plastic nameplates on the trim per Section 26 05 53.UT, Electrical Identification
- C Bus:
1. Provide panelboards with rounded edge phase, neutral and ground buses, rated full capacity as scheduled on drawings. Buses shall be full-length copper and braced for the maximum available fault current as shown on drawings. Neutral bus shall be 200% rated for those panels feeding non-linear loads.
  2. Phase bussing shall be stacked front-to-back, A-B-C.



3. The neutral and ground bus bars shall have termination locations for each of the individual feeders and the lugs sized appropriately. In addition, space shall be provided to terminate the neutrals and grounds in two feeders equal to the largest size circuit breaker that can be installed in the panelboard. The ground bus shall be mounted in the panelboard, opposite the incoming line and neutral lugs and shall be accessible to allow easy installation of bolts, nuts and lock washers used to attach ground lugs. The neutral and ground buses in branch circuit panelboards shall have spaces to terminate 42 neutral and 42 ground wires.
4. Where isolated ground buses are specified or indicated, provide copper grounding bus bars mounted in the panelboard on insulated standoffs to ensure isolation from equipment ground potential. Isolated ground buses shall be drilled and tapped as appropriate for connection of the individual isolated grounding conductors.
5. All lugs for phase, neutral, and ground buses shall be tin-plated copper.
6. Panelboard shall be rated SE where required for service Entrance duty.

### **2.3 SWITCHING AND OVERCURRENT PROTECTIVE DEVICES**

- A. Provide molded case circuit breakers with manufacturer's standard construction, bolt on type, with integral inverse time delay thermal and instantaneous magnetic trip in each pole. Circuit breakers shall be constructed using glass reinforced polyester insulating material providing superior dielectric strength. Provide circuit breakers UL listed as Type HACR for air-conditioning equipment branch circuits.
- B. Circuit breakers shall have an over center, trip-free, toggle operating mechanism that will provide a quick-make, quick-break contact action.
- C. Provide handle padlock attachments on circuit breakers where indicated on drawings. Device shall be capable of accepting a single padlock. All circuit breakers shall be capable of being individually padlocked in the off position.
- D. The circuit breakers shall be connected to the bus by means of solidly bolted connection. In multi-pole breakers, the phase connections on the bussing shall be made simultaneously without additional connectors or jumpers. Multi-pole breakers shall be two or three pole as specified. Handle ties are not permitted. The circuit breaker shall have common tripping for all poles.
- E. All circuit breakers shall be provided with visible ON and OFF indications.
- F. Provide GFI circuit breakers as indicated on drawing or per NEC requirement.
- G. Breaker voltage and trip rating shall be per drawings. Breaker faceplate shall indicate UL certificate standards with applicable voltage systems and corresponding short current rating as per drawings.
- H. Molded Case Circuit Breakers:
  1. Breakers 400 ampere frame and less shall be manufacturer's standard industrial construction, bolt-on type, integral inverse time delay thermal and instantaneous magnetic trip. Breakers 225 ampere through 400 ampere shall have continuously adjustable magnetic pick-ups of approximately five to ten times trip rating.
  2. Breakers 600 ampere frame and above shall be equipped with solid-state trip complete with built-in current transformers, solid-state trip unit and flux transfer shunt trip.
- I. Current Limiting Molded Case Circuit Breakers:
  1. Breakers 100 ampere frame shall be inverse time delay thermal and instantaneous magnetic trip.
  2. Breakers 250 ampere and 400 ampere frame shall be solid-state trip with built-in current transformers, solid-state trip unit and flux transfer shunt trip.

3. Current limiting breakers shall protect downstream molded case breakers. Submit manufacturer's test data proving the protection, from both peak currents and I<sup>2</sup>T energy of downstream devices.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install panelboards in accordance with manufacturer's written instructions and the applicable requirements of the NEC, NEMA, ANSI and the National Electrical Contractors Association's "Standard of Installation".
- B. Anchor enclosed firmly to walls and structural surfaces, ensuring that they are permanently and mechanically secured. Direct attachment to dry wall is not permitted. Freestanding panelboards shall be installed on a concrete housekeeping pad with anchors per manufacturer's recommendation.
- C. Mounting height:
  1. Distribution Panelboards: As per Drawings, but such that highest operating handle is no greater than 79 inches above finished floor.
  2. Branch Circuit Panelboards: As per Drawings, but such that highest operating handle is no greater than 79 inches above finished floor.
  3. Where panelboards occur in groups, the tops shall be aligned if it can be done without exceeding items 1 and 2 above.
- D. Install panelboards plumb. Adjust trim to cover all openings. Seal all conduit openings and cap all used knockout holes.
- E. Provide blank plates for unused open spaces in panelboards. Keep the front door closed after work to protect from damage, dirt, and debris at all times.
- F. Install identification nameplates in accordance with Section 26 05 53.UT, Electrical Identification.

#### **3.2 FIELD QUALITY CONTROL**

- A. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers and lugs.
- B. Provide testing and start-up as indicated in Section 26 08 00 – Commissioning of Electrical Systems.

#### **3.3 PANELBOARD SCHEDULE**

- A. The Contractor shall provide engraved, laminated plastic nameplates for circuit identification as indicated on the Drawings for distribution panelboards.
- B. The Contractor shall fill the index directory inside the front door of branch circuit panelboards identifying each circuit as shown on Panel Schedule drawings. Where changes are made, the schedule shall reflect the changes. At the end of the job, these schedules shall reflect as-built record conditions.

### **END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

## SECTION 26 27 26

### WIRING DEVICES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS:

- A. The Conditions of the Contract and applicable requirements of Divisions 0 and 1 and Section 26 00 01, "Electrical General Provisions", govern this Section.

##### 1.2 DESCRIPTION OF WORK:

- A. Work Included: Provide wiring device work as shown, scheduled, indicated, and as specified.
- B. Types: The types of wiring devices required for the project include, but are not limited to, the following:
  - 1. Receptacles.
  - 2. Switches.
  - 3. Pushbuttons.
  - 4. Wall plates.

##### 1.3 STANDARDS:

- A. Products shall be designed, manufactured, tested, and installed in compliance with the following standards:
  - 1. NEMA WE 1      General-purpose wiring devices.
  - 2. NEMA WD 5      Specific-purpose wiring devices.

##### 1.4 QUALITY ASSURANCE:

- A. Manufacturers: Provide products complying with these specifications and produced by one of the following:
  - 1. Harvey Hubbell, Inc.
  - 2. Leviton.
  - 3. Pass and Seymour, Inc.
  - 4. Taymac Corporation.
  - 5. Wiremold Company.
- B. UL Label: All wiring devices shall be UL-labeled.

##### 1.5 SUBMITTALS:

- A. Shop Drawings submittals shall include, but not be limited to, the following:
  - 1. Cut sheets of the receptacles, switches and pushbuttons.
  - 2. Cut sheets of the wall plates.
  - 3. Additional information as required in Section 26 00 01, "Electrical General Provisions".

1.6 DELIVERY, STORAGE AND HANDLING:

- A. Deliver wiring devices individually wrapped in factory-fabricated containers.
- B. Handle wiring devices carefully to avoid damage, breaking, and scoring.
- C. Store in a clean dry space and protect from the weather.

PART 2 - PRODUCTS

2.1 WIRING DEVICES:

A. General: Provide factory-fabricated wiring devices in the type, color, and electrical rating for the service indicated. Where type and grade are not indicated, provide proper selection to correspond with branch circuit wiring and overcurrent protection. Attachment of wires to devices shall be by screw pressure under the head of binding screws. Arrangements depending on spring pressure or tension are not acceptable. All binding screws shall be brass or bronze.

B. Receptacles: Comply with NEMA Standard WD1 and as follows:

1. General Duty Decorator: Provide simplex or duplex commercial specification grade decorator type receptacles, 2-pole, 3-wire grounding, with green hexagonal equipment ground screw, ground terminals and poles internally connected to mounting yoke, with metal mounting straps, back and side wired with screw type terminals, molded high impact thermoplastic compound, NEMA configuration as indicated.

- a. 20 amp, 125 volt grounded simplex NEMA #5-20R Pass & Seymour #26361-\*. Leviton #16351-\*.
- b. 15 amp, 125 volt grounded duplex NEMA #5-15R Pass & Seymour #26252-\*. Leviton #16252-\*.
- c. 20 amp, 125 volt grounded duplex NEMA #5-20R Pass & Seymour #26352-\*. Leviton #16352-\*.
- d. 20 amp, 125 volt, Class A, GFCI duplex receptacle with integral ground fault current interrupter, back and side wired with indicator light. Pass & Seymour #2095\*L. Leviton #GFNT2-\*.
- e. 20 amp, 125 volt, Class A, GFCI duplex receptacle with integral ground fault current interrupter, back and side wired with indicator light hospital grade. Pass & Seymour #2095HG\*L. Leviton #7899-HG\*.

\* Color designation, refer to Paragraph 2.3.

Wiring devices connected to Designated power circuits shall be as specified hereinabove except that wiring devices shall be gray in color with coverplates color-matching other devices in the room.

2. Heavy-duty Simplex: Provide single heavy-duty type receptacles, with green hexagonal equipment ground screw, with metal mounting straps, back wiring, black molded phenolic compound, NEMA configuration as indicated.

- a. 30 amp, 125 volt grounded single NEMA #5-30R Hubbell #HBL9308 with #S703 stainless steel wall plate.
- b. 30 amp, 250 volt, grounded, 3-wire, 2-pole NEMA #6-30R Hubbell #HBL9330 with #S703 stainless steel wall plate.



- b. Specification grade, Type 302, satin-finished stainless steel, 0.1" thick for heavy duty receptacles and kitchen receptacles.

### 2.3 **WIRING DEVICE/COVERPLATE COLORS:**

- A. General: Provide general duty wiring devices and coverplates in colors as follows:
  - 1. Painted Drywall: Provide white general use receptacles and switches and gray Designated receptacles with matching white thermoplastic coverplates in occupied areas and white Lexan coverplates in mechanical/electrical and maintenance areas. Final color selected shall be by the Architect.
  - 2. Wood and Stone Wainscoting: Provide receptacles, switches and coverplates in finished and materials as selected by the Architect.]
  - 3. Kitchen: Provide white wiring devices with stainless steel coverplates above 36" above finished floor and weatherproof Lexan coverplates below 36" above finished floor.

## **PART 3 - EXECUTION**

### 3.1 **INSPECTION:**

- A. Installer must examine the areas and conditions under which wiring devices and floor boxes are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Inspect devices for physical damage. Do not proceed with the work until unsatisfactory conditions have been corrected.

### 3.2 **INSTALLATION OF WIRING DEVICES:**

- A. General:
  - 1. Install wiring devices where shown, in accordance with manufacturer's written instructions, applicable requirements of NEC and in accordance with recognized industry practices to ensure that products serve intended function. Delay installation of devices until wall construction and wiring is completed.
  - 2. Special purpose switches and/or outlets not covered by the specifications, but noted on the Drawings shall be of the amperage, voltage rating, and NEMA configuration indicated. The switches and/or outlets shall be specification grade of the same quality as those specified.
  - 3. When "**EQUIPMENT ONLY**" or "**JUNCTION BOX ONLY**" is indicated for equipment, it shall be the responsibility of the Electrical Subcontractor to obtain from the supplier, the complete data as related to the electrical portion of the equipment, including rough-ins, mounting height, type of outlet, items furnished by the supplier, etc. The Electrical Subcontractor shall be responsible for furnishing and installing all materials which are usually the Electrical Subcontractor's responsibility with the installation of the equipment.
  - 4. The approximate location of switches, power outlets, floor boxes, etc., is indicated on the Drawings. These Drawings, however, may not give complete and accurate information in regard to locations of such items. Determine exact locations by reference to the general building Drawings and by actual measurements during construction of the building before rough-in, subject to the approval of the Construction Inspector.
- B. Box Condition: Install receptacles and switches only in electrical boxes which are clean, free from excess building materials, debris, and similar matter.

- C. Device Wiring:
1. Wire all wiring devices using the terminal screws. Spring loaded back wiring shall not be used. Tape around wiring device terminal screws and exposed electrical parts with a minimum of three wraps of 3M or approved equal electrical tape.
  2. Wire all non-dedicated receptacles and switches utilizing parallel circuiting with pigtails.
  3. Use a torque screwdriver to tighten wiring device terminal screws per manufactured recommendations. Tighten unused terminal screws on the devices.
- D. Finish/Alignment: Install all wiring devices plumb and aligned in the plane of the wall, floor, or ceiling in which they are installed. Check all devices by pressing the face of the devices. Devices shall not move toward in to the wall. There should not more than 1/8" gap between all sides the device boxes and the wall finish. Repair wall finishes and remount outlet and switches boxes when device plates do not fit or flush. Do not cover wall opening by using oversized cover plates.
- E. Switches: Install switches at a height as specified in Section 26 05 01, "Electrical Basic Materials and Methods", to switch center line, unless otherwise noted on Drawings, on the strike side of doors as hung and in a uniform position so that the same direction will open and close the circuit throughout the project. Where shown near doors, install switches and dimmers not less than 2" and not more than 12" from door trim. Where more than one switch is in the same location, install switches in a multi-gang box with a single coverplate. Use toggle switches for motor disconnect switches only when installed in a ceiling plenum or in a mechanical, electrical, or telephone room.
- F. Receptacles: Install receptacles vertically at a height as specified in Section 26 05 01, "Electrical Basic Materials and Methods", to receptacle center line above finished floor and horizontally at a height as specified in Section 26 05 01, "Electrical Basic Materials and Methods", to receptacle center line above counter tops unless shown or specified otherwise. Where splash backs occur above counters, mount devices horizontally at a height as specified in Section 26 05 01, "Electrical Basic Materials and Methods", to receptacle center line above splash backs. Receptacles shall be installed with ground pin receiver down. All devices shall be installed complete with coverplates.
- G. Connections: All wiring devices shall use pigtail and conductors shall be directly terminated and connected around device terminal screws. Push-in connections and through wiring are wiring devices is not permitted.
- H. Coverplates:
1. Install stainless steel coverplates on all heavy-duty receptacles and wiring devices located in kitchen areas. Coffee bars shall not be considered kitchen areas. Install weatherproof coverplates on all exterior and wet area receptacles. Refer to Paragraph 2.03 for additional requirements.
  2. Multi-gang wall plates shall be used for each group of ganged devices. Mounting screws shall be installed for each device covered by the wall plate.
  3. Wall plates for concealed work shall be flush against the finished wall, and shall completely cover the wall opening. Wall plates shall not be installed until all painting has been completed. Devices shall be protected by masking tape or other coverage until painting is complete. Any device with paint on it shall be replaced at no expense to the Owner. Jumbo plates are not acceptable.
  4. Engrave and black paint fill text descriptions and branch circuit numbers on switch and receptacle coverplates where shown on the Drawings or specified herein.
- I. Mounting Heights: Refer to Section 26 05 01, "Electrical Basic Materials and Methods", for wiring device mounting heights.

3.3 **PROTECTION OF WALL PLATES AND RECEPTACLES:**

- A. **General:** Upon installation of wall plates and receptacles, advise Contractor regarding proper and cautious use of convenience outlets. At time of Substantial Completion, replace those items which have been damaged, including those burned and scored by faulty plugs.

3.4 **IDENTIFICATION:**

- A. Refer to Section 26 05 53, "Electrical Identification", for wiring device identification requirements.

3.5 **TESTING:**

- A. General: Prior to energization, check for continuity of circuits, for short circuits and check grounding connections.
- B. Testing: After energization, check wiring devices to demonstrate proper operation, including GFCI trip and receptacle polarization using instruments that comply with UL 1436. Tests shall be diagnostic and include damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices or similar problems. Correct circuit conditions, remove malfunctioning devices and replace with new devices and retest.

**END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068



## SECTION 26 28 13

### FUSES, 600 VOLT

#### PART 1 - GENERAL

##### 1.1 WORK INCLUDED

- A. Dual-element, current limiting Class R fuses for loads up to 600 volts, 0-600 Amps.
- B. Time delay, current limiting Class L fuses for loads up to 600 volts, 601-6000 Amps.

##### 1.2 REFERENCES

- A. UL 248-12 - Standard For Safety For Low-Voltage Fuses-Part 12: Class R Fuses
- B. UL 248-10 - Standard For Safety For Low-Voltage Fuses-Part 10: Class L Fuses
- C. Where application of local codes, trade association standard or publications appears to be in conflict with the requirements of this Section, the Architect/Engineer shall be asked for an interpretation.

##### 1.3 SUBMITTALS

- A. Provide submittals in accordance with and in additional to Section 26 00 00.UT, Basic Electrical Requirements, and Division 01 for submittal requirement.

##### 1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Store fuses in a clean and dry space and protected from weather. When necessary to store outdoors, elevate materials well above grade and enclose with durable, waterproof wrapping.

#### PART 2 - PRODUCTS

##### 2.1 MATERIAL AND EQUIPMENT

- A. Furnish fuses manufactured by Buss, or equal, in accordance with the following:
  - 1. Motors and Transformers, 0 to 600 Amp:
    - a. 250 volt - Buss LPN-RK, UL Class RK1.
    - b. 600 volt - Buss LPS-RK, UL Class RK1.
  - 2. Lighting Loads, 0 to 600 Amp:
    - a. 250 volt - Buss KTN-R, UL Class RK1.
    - b. 600 volt - Buss KTS-R, UL Class RK1.
  - 3. All Applications, 601 to 6000 Amp:
    - a. 600 volt - Buss KRP-C, UL Class L.
- B. Size fuses serving motor loads as specifically recommended by motor or equipment manufacturer or in the range of 150% to 175% of motor nameplate rating per NEC in accordance to the type of motor.
- C. Interrupting Rating: 300,000 RMS Amps.
- D. Maintenance Stock, Fuses:
  - 1. Furnish the following:
    - a. Three spare fuses of each size and type for a spare set.

- b. Furnish spare fuse cabinet sized to contain required spare fuse stock.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Install fuses where indicated, in accordance with the manufacturer's written instructions, the applicable requirements of NEC, national and local codes, regulations, and requirements.
- B. Provide quantity of spare fuses and fuse cabinet per the requirement of this Section at the location per drawing or the direction of Owner's Representative, in addition to replace blown or defective fuses during installation, startup, system commissioning and acceptance.

**END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

## SECTION 26 28 16

### DISCONNECT SWITCHES

#### PART 1 GENERAL

##### 1.1 WORK INCLUDED

- A. Disconnect switches, fusible and non-fusible.
- B. Enclosures.

##### 1.2 REFERENCES

- A. Federal Spec. W-S-865 - Switch, Box (Enclosed), Surface-Mounted.
- B. NEMA KS 1 - Enclosed Switches.
- C. NFPA 70 - National Electrical Code
- D. NFPA 70E - Electrical Safety Requirement for Employee Workplaces
- E. UL 98 - Enclosed Switches1.

##### 1.3 SUBMITTALS

- A. Provide submittals in accordance with and in addition to Section 26 00 00.UT, Basic Electrical Requirements, and Division 01 for submittal requirement.
- B. Submit manufacturer's product data. Submit dimensioned drawings and equipment ratings for voltage, capacity, horsepower, and short circuit.

##### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver switches individually wrapped in factory-fabricated water-resistant type containers.
- B. Handle switches carefully to avoid damage to material components, enclosure and finish. Damaged switches shall not be installed on project.
- C. Store switches in a clean and dry space and protected from weather.

#### PART 2 PRODUCTS

##### 2.1 FABRICATED SWITCHES

- A. NEMA KS 1; Type HD quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Handle lockable in ON position for service entrance disconnect. Provide defeater so that qualified personnel can open door while switch is in the closed position.
- B. Use switches that have number of poles required as per drawings.
- C. Switches shall be Underwriters' approved for duty shown and enclosure type per drawings. NEMA 3R switches shall be provided where exposed to weather. NEMA 3R switches shall have weatherproof threaded hubs for all conduit entries into switch.
- D. Use fuse clips that are rejecting type to accept Class RK or L fuses only.
- E. Identify switches, as to equipment served, with engraved laminated plastic plates. Refer to 26 05 53 Electrical Identification Section of this specification.
- F. Voltage rating: 240VAC or 600VAC as per drawings.

## **PART 3 EXECUTION**

### **3.1 INSPECTION**

- A. Installer shall examine the areas and conditions under which safety and disconnect switches are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION OF SAFETY AND DISCONNECT SWITCHES**

- A. Install safety or disconnect switches, where required by NEC, where indicated on drawings, and where required by equipment manufacturer, in a location convenient for maintenance on switch and adjacent equipment.
- B. For equipment with motors larger than 1/8 hp, install disconnect switches within sight of the motor.
- C. Provide fused disconnect switches, whether or not indicated on drawings, when required to maintain equipment manufacturer's warranty. Coordinate with Division 23 for warranty requirements of equipment approved by submittal.
- D. Install fuses in fusible disconnect switches. Provide permanent marking inside switch enclosure for fuse type.
- E. Wall mount switches, where possible, or mount on unistrut supports.

### **END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

**SECTION 26 51 00**  
**INTERIOR LIGHTING**

**PART 1 - GENERAL**

**1.1 WORK INCLUDED**

- A. Interior lighting fixtures and accessories
- B. Emergency lighting units
- C. Emergency exit signs
- D. Emergency fluorescent lamp power supplies
- E. Lamps
- F. Ballasts
- G. Lighting controls

**1.2 REFERENCES**

- A. NEPA 101 - Code for Safety to Life from Fire in Buildings and Structures
- B. NEMA WD1 - General-Purpose Wiring Devices
- C. ANSI C82.1 - Specification for Fluorescent Lamp Ballasts
- D. ANSI C82.4 - Specifications for High-Intensity-Discharge Lamp Ballasts (Multiple Supply Type)
- E. NEMA LE - H-I-D Lighting System Noise Criterion (LS-NC) Ratings
- F. UL 844 - Electric Lighting Fixtures for Use in hazardous (classified) Locations
- G. UL 924 - Emergency Lighting and Power Equipment
- H. UL 935 - Fluorescent-Lamp Ballasts
- I. UL 1029 - High-Intensity-Discharge Lamp Ballasts
- J. UL 1572 - High Intensity Discharge Lighting Fixtures
- K. UL 1574 – Track Lighting Systems
- L. IESNA – Lighting Handbook
- M. NEMA WD 1 - General Color Requirements for Wiring devices
- N. NEMA LE 5B – Procedure for Determine Luminaire Efficacy Ratings for High-Intensity Discharge Industrial Luminaires
- O. NFPA 70 – National Electrical Code
- P. ASHRAE/IES 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings
- Q. Standards For State-Funded Outdoor Lighting Fixture – Texas House Bill 916 (1999)
- R. UT System OFPC – Security Planning and Design Guidelines (2002 release)

**1.3 DESIGN CRITERIA**

- A. Lighting level design shall be per IESNA (Illuminating Engineering Society of North America) recommendation.
- B. The power consumption for interior and exterior lighting shall not exceed power allowance as per ASHRAE 90.1 latest revision.

## 1.4 SUBMITTALS

- A. Provide submittals in accordance with and in addition to Section 26 00 00, Basic Electrical Requirements, and Division 1 for submittal requirement.
- B. Submit manufacturer's data on interior and exterior lighting fixtures in booklet form, with separate sheet for each fixture, assembled by luminaire "type" in alphabetical order, with the proposed fixture and accessories clearly labeled.
- C. Submit dimensioned drawings and performance data including complete photometric test data for each luminaire, candlepower distribution curves in two or more planes, candlepower chart zero to 90 degrees, lumen output zonal summary chart, average and maximum brightness data, and coefficients of utilization for zonal cavity calculations, spacing to mounting height ratio, efficiency and visual comfort probability. Also provide luminaire weights, mounting data, and accessory information for each luminaire type.
- D. Lamps: Catalog cuts showing voltages, colors, approximate hours life, approximate initial lumens, lumen maintenance curve, lamp type and base.
- E. Ballasts: Catalog cuts showing type, wiring diagram, nominal watts, input voltage, starting current, input watts, sound rating, power factor and low temperature characteristics.
- F. Controls: Catalog cuts and/or shop drawings showing dimensions, voltage capacity, contact ratings, wiring diagrams, operating levels, and temperature ratings.
- G. Lighting design shall be in compliance with power allowance for lighting, which is stipulated by ASHRAE 90.1. Compliance forms along with engineering data associated with it shall be submitted for Owner's review during design phase.

## 1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver lighting fixtures individually wrapped in factory-fabricated fiberboard type containers. Parabolic louvers shall be shipped in thermally sealed polyethylene wrapper.
- B. Handle lighting fixtures carefully to prevent breakage, denting and scoring the fixture finish. Do not install damaged lighting fixtures.
- C. Store lighting fixtures in a clean, dry space and protected from the weather.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Lighting fixtures and accessories shall comply with the design and function requirements of the project. Design characteristics shall be as noted in manufacturer's submittal data.
- B. Provide lighting fixtures of the size, type and rating as scheduled, complete with, but not limited to, lamps, lamp holders, reflectors, ballasts, poles and wiring.

### 2.2 INTERIOR LIGHTING FIXTURES

- A. Fluorescent Fixtures
  - 1. See plans for light fixture schedule.
- B. Incandescent fixtures shall be pre-wired equipped with integral thermal protection. Use incandescent only where aesthetics outweighs economic considerations.
- C. Lighting track shall be surface mount or pendant mount per the requirement on drawings, by manufacturer of track mounted light fixtures.
- D. High Bay, Low Bay HID Fixtures
  - 1. Provide rugged, lightweight, cast aluminum ballast housing with a baked electro-coat paint finish.

2. Optic reflector shall be fully fluted, anodized aluminum providing high efficiency. Where enclosed and gasketed type fixtures are specified, provide luminaires designed for continuous operation in an ambient temperature of 55° C.

E. Lamp Holders or Sockets

4. Lamp holders and sockets shall be provided with minimum 18 AWG wiring leads.

F. Reflector Finishes

1. Painted Finishes: Provide electro-statically applied dry polyester white powder coat finish with minimum reflectance of 88 percent on all light reflecting surfaces.
2. Specular/Semispecular Finishes: Provide Alzak-type anodized finish on aluminum louvers and reflectors as specified in Luminaire Schedule as shown on the drawings. Minimum reflectivity shall be:
  - a. Specular: 80 percent
  - b. Semi-specular: 75 percent

G. UL Listing

1. All Luminaries and components shall be UL tested, listed, and labeled.
2. Luminaries installed under canopies, roofs, or similar damp or wet locations shall be UL listed and labeled as suitable for damp or wet locations.
3. Recessed luminaries installed in fire rated ceilings and using a fire rated protective cover shall be thermally protected for this application and shall be approved for the installation in a fire-rated ceiling.

## **2.7 BALLASTS**

A. Acceptable Manufacturers

1. Valmont
2. Advance
3. Magnetek
4. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in 26 00 00, and Division 1 for substitution requirement.

## **PART 3 - EXECUTION**

### **3.1 INSPECTION**

- A. Prior to order lighting fixture, check the building electrical system requirements, architectural finishes, and the type of ceilings that lighting fixture will be installed. Any discrepancies of compatibility pertaining trim, frames, color, mounting, ballast, voltage and etc. shall be brought to the attention of A/E by written notice. Do not proceed with procurement until discrepancies are resolved in a satisfactory manner.
- B. Installer shall examine the areas and conditions that light fixtures are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION OF LIGHTING FIXTURES**

- A. Install light fixtures in accordance with the manufacturer's written instructions, the applicable requirements of NEC and national and local code, standard, and regulations. Install lamps in accordance with manufacturer's instructions.

- B. Install luminaries at locations as shown on the Drawings; install aligned, aimed, and leveled. Install fixtures in accordance with manufacturer's installation instructions complete with mounting accessories, trim and support materials. Fasten fixtures securely to structural support members of the building; solid pendant fixtures shall be plumb.
- C. Coordinate with other crafts to avoid conflicts between luminaires, supports, fittings and mechanical equipment.
- H. Lighting Fixtures Adjustment
  - 1. Adjust to illuminate intended areas as directed.
  - 2. Adjust exterior fixtures during hours of darkness.
- I. Immediately before final observation, clean all fixtures, inside and out, including plastics and glassware, and adjust all trim to properly fit adjacent surface, replace broken or damaged parts, and lamp and test all fixtures for electrical as well as mechanical operation.
- J. Protect installed fixtures from damage during the remainder of the construction period.
- K. Upon completion of installation of interior lighting fixtures, and after circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.
- L. Incandescent lamps shall be new at time of final acceptance. Fluorescent lamps may be used in the final finishing of the building. Those that have exceeded more than 1/3 of their rated life (as established by Construction Inspector records), or that have blackened ends or inoperable shall be replaced with new lamps before final acceptance.
- M. Lamp Disposal
  - 1. The procedure of disposal of lamps that are mercury containing shall follow the guideline set by EPA (definitions in Title 40 Code of Federal Regulations 261 Subpart C, January 2000).

**END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068



## SECTION 28 31 00

### FIRE ALARM AND SMOKE DETECTION SYSTEM

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS:

- A. The Conditions of the Contract and applicable requirements of Division 1, "General Requirements" and Section 26 00 00, "Basic Electrical Requirements", govern this Section.

##### 1.2 DESCRIPTION OF WORK:

- A. General: The extent of fire alarm system work is as shown and scheduled and includes, but is not limited to, providing a system with the following functions and operations:
1. Provide new fire alarm devices fully installed wired and interfaced to the existing addressable device fire alarm system in the building. All devices, fire alarm system materials, wiring and installation methods shall match the existing fire alarm system installation in the building.
  2. Provide labor and software programming to upgrade the graphic annunciation of UCT at the remote UTPD monitoring station. Coordinate integration of work with UTPD.
  3. All fire alarm system final connections and interfaces to the existing fire alarm system shall be made by Grinnell, the building fire alarm system installer.
  4. All smoke detectors need to be labeled with the point number on the exterior of the device.
  5. All pullstations need to be keyed to CAT 30.
  6. Upon completion of the fire alarm installation updated CAD files need to be submitted to the owner.
- B. The building fire alarm system expansion shall be designed, prepared, documented and signed by a State of Texas licensed fire alarm planning superintendent employed by the State Licensed Fire Alarm Contractor installing the building fire alarm system in accordance with the project specifications, all applicable codes and standards, the requirements of the AHJ and all applicable Standards.
- C. Fire alarm devices and functions shown on the drawings are for general scope and coordination only and all fire alarm devices and components required by the project specifications, all applicable codes and standards and the AHJ shall be provided. All fire alarm devices and functions, including devices and functions in addition to those required by the specifications or shown on the drawings and as required by all applicable codes and standards and the AHJ shall be provided as part of the project scope. Where additional fire alarm devices are shown on the drawings and are allowed by applicable codes and standards and the AHJ, these devices shall be included in the project fire alarm system design.
- D. Preliminary plans showing the proposed locations for all fire alarm devices exposed to view in tenant spaces shall be submitted to the Architect for review prior to completion of the fire alarm system design. Any device relocations or additions required based on the Architect's review shall be provided at no additional cost as a part of project coordination,
- E. The fire alarm system and device information shown on the Drawings is intended to supplement this specifications as it relates to establishing the scope for the building fire alarm system which is to be designed, prepared, documented and signed by a State of Texas licensed fire alarm planning superintendent employed by the State Licensed Fire Alarm Contractor is not a fire alarm system design.

- F. The fire alarm system tenant expansion components and sequence of operation shall match the Base Building fire alarm system.

**1.3 STANDARDS:**

- A. Products shall be designed, manufactured, tested, and installed in compliance with the latest edition of the following standards:
  - 1. National Fire Protection Association Standards including NFPA 72-2002, as applicable.
  - 2. Underwriters' Laboratories, Inc. Requirements and Listing for use in Fire Protective Signaling Systems as applicable.
  - 3. The requirements of State Fire Marshal and local authorities having jurisdiction.
  - 4. Comply with requirements of the Americans with Disabilities Act of 1990.

**1.4 QUALITY ASSURANCE:**

- A. Manufacturers: All fire alarm system equipment shall match the original building fire alarm system manufacturer to assure compatibility.
- B. UL and FM-listing: All fire alarm system components shall be UL and FM listed for fire alarm use. The UL listing shall be under category UOJZ to assure that the entire system has been tested as an integral life safety system.
- C. All equipment furnished shall be the current standard products of a single manufacturer and shall bear the label of the Underwriters' Laboratories for use in fire alarm system designed in compliance with the requirements of NFPA codes. Raceways, wiring and terminations shall be accomplished in compliance with the requirements of the National Electric Code, Article 760, except that all wiring shall be in EMT or an approved raceway.
- D. The system as installed shall, upon completion, be certified by a state licensed fire alarm installation superintendent to the Owner as being installed in compliance with the specification, the requirements of all state and local codes, and as being operational and free from defects.
- E. All system equipment supplied shall be listed by the Underwriters' Laboratories for NFPA 72 system use, and all applicable NFPA Codes.
- F. The installing contractor shall be authorized and designated representative of the fire alarm system manufacturer to sell, install and service the manufacturer's equipment and shall stock the required spare parts to keep the system in operation. The installing contractor shall maintain a staff of specialists for technical assistance and system maintenance.
- G. The installing contractor must be licensed by the State Fire Marshal to sell, install, and service fire alarm system as required by Article 5.43-2 of the Texas Insurance Code.
- H. The installing contractor shall have on his staff a minimum of five installation superintendents who are licensed by the State Fire Marshal's office for such purpose and under whose supervision installation, final connections and check out will take place, as required by the Texas Insurance Code.
- I. The installing contractor or equipment supplier shall have a staff a minimum of one certified NICET Level II state licensed fire alarm planner under whose supervision system design shall take place. In lieu of a NICET-certified state licensed fire alarm planner, the contractor or supplier may provide design supervision with a graduate or professional electrical engineer.
- J. The equipment supplier shall provide 24 hour, 365 days per year emergency service with qualified and state-licensed service technicians.

- K. The installing contractor shall have been actively engaged in the business of selling, installing, and servicing microprocessor and multiplex fire alarm systems for at least 8 years and shall have proof of experience in the installation and maintenance of the type of fire alarm system specified herein.
- L. The manufacturer or his representative shall maintain within 50 miles of the installation, a staff of factory trained, state licensed fire technicians, together with all support parts necessary for maintenance of the system.
- M. Where approved in writing by the system manufacturer and installing contractor, the Electrical Contractor may install all conduit and boxes. The system wiring shall be pulled in by the installing contractor. All system connections, device installation, system start-up and testing shall be performed by the installing contractor. Rough-in by the electrical contractor shall not in any way affect the system manufacturer's and installing contractor's full responsibility for the installed fire alarm system.
- N. The manufacturer shall submit legal documentation indicating that the purchased fire alarm equipment will be provided with parts, and support for 10 years after the acceptance by the Owner.
- O. Plenum cables are not acceptable. All wiring shall be listed for limited energy fire alarm use and rated for 300 volts minimum and installed in a suitable conduit or raceway.
- P. The complete combination fire alarm system shall comply with the requirements of the Texas State Fire Marshall. Modifications required to provide compliance shall be made at no cost to the Owner. Where Contract Document requirements are in excess of Code requirements are permitted under the Code, the Contract Documents shall govern.

**1.5 SUBMITTALS:**

- A. Shop Drawings submittals shall include, but not be limited to, the following:
  - 1. A block diagram showing system components, wire runs, wire counts and wire sizes.
  - 2. Manufacturer's descriptive literature for all panels, modules and peripheral equipment describing size, color, finish, capacity and electrical characteristics.
  - 3. Completely identified and marked catalog cuts of all associated equipment and devices, with all non applicable items crossed out, or applicable devices clearly highlighted and/or identified.
  - 4. Complete and detailed point-to-point wiring diagrams for all devices in the system.
  - 5. Complete Bill of Material for all equipment.
  - 6. A copy of the form to be used for final tests, 100% audit and checkout shall be submitted for approval.
  - 7. Additional information as required in Section 26 00 00.

**1.6 DELIVERY, STORAGE AND HANDLING:**

- A. Deliver fire alarm system components in factory-fabricated containers.
- B. Store in a clean, dry space and protect from the weather.
- C. Handle fire alarm system components carefully to avoid damage to material components, enclosure and finish.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS AND COMPONENTS:**

- A. General: Provide the required fire alarm system products in the sizes and capacities required or indicated, complying with the manufacturer's published product information of standard materials and components, designed and constructed for the applications indicated.

### **2.2 SYSTEM OPERATION:**

- A. General: System operation for new fire alarm devices shall match existing operation.
- B. System Wiring Supervision: Supervision of new fire alarm wiring shall match existing fire alarm system wiring supervision.

### **2.3 SYSTEM DEVICES:**

- A. General: System devices shall be located as shown on the Drawings. The Contractor shall refer to all the drawings to determine where devices are to be located. All system devices shall be numbered with a unique number. The numbering system shall include the building area, type of device, and device number. This numbering system shall be shown on each submitted floor plan drawing, fire alarm riser diagram and be tabulated. The tabulation shall be included in each O&M Manual submitted to the Owner.

### **2.4 SYSTEM ZONING:**

- A. General: The system shall employ "intelligent" smoke detectors and addressable interface devices capable of being recognized and annunciated at the main control panel and CRT terminals on an individual basis. All devices shall be field-programmed into software zones for the purpose of general area identification and annunciation. However, each device shall also be annunciate identified on an individual basis including exact location and device type. All zoning/device location information shall be totally field-programmable to exact job requirements. Devices shall be zoned as follows:
  - 1. Area smoke detectors shall be zoned by floor.
- B. Initiating and monitored devices shall include, but not be limited to, the following:
  - 1. Ceiling smoke detectors.
  - 2. Addressable manual pull stations with firefighters telephone jacks.
  - 3. Addressable input/output devices.
- C. The system shall utilize remote transponder panels for distributed voice communications, firefighters' telephone conventional zoned initialing circuits and auxiliary control output circuits. Remote transponder panels shall communicate with the main CPU via the SLC data loop and be capable of being intermixed on the same loop as intelligent heat and smoke detection and control modules.
- D. Output devices shall include, but not be limited to, the following:
  - 1. Wall and ceiling alarm speakers/visual signals.
  - 2. Addressable interface relays.

### **2.5 FIRE ALARM SYSTEM CENTRAL EQUIPMENT:**

- A. General: The Fire Alarm Control Panel and equipment is existing and shall be reused.

## 2.6 REMOTE TRANSPONDER PANELS:

- A. General: The Fire Alarm transponder panels are existing and shall be reused.

## 2.7 ALARM SIGNAL DEVICES:

- A. All new fire alarm signal devices shall match existing and be UL listed for use with the existing building fire alarm system.
- B. Ceiling Mounted Fire Alarm Speakers: Wheelock "E" Series or equal to match existing flush mounted fire alarm speakers which match existing devices used in the building shall be provided. Ceiling mounted fire alarm speakers shall have a white finish.
- C. Wall Mounted Fire Alarm Speakers/Visual Signals: Wheelock "E" Series or equal to match existing recess/surface mounted fire alarm speakers with integral visual signals which match existing devices used in the building shall be provided. Wall mounted fire alarm speaker/visual signals shall have a white finish. Visual signal candela ratings shall be in compliance with applicable codes and standards.
- D. Wall Mounted Fire Alarm Visual Signals: Wheelock "E" Series or equal to match existing recess/surface mounted fire alarm visual signals which match existing devices used in the building shall be provided. Wall mounted fire alarm visual signals shall have a white finish. Visual signal candela ratings shall be in compliance with applicable codes and standards.

## 2.8 SYSTEM WIRING:

- A. The equipment supplier shall furnish to the installing contractor a complete detailed point-to-point wiring diagram showing the system equipment and required number, type and sizes of conductors and conduit sizes. Where common devices which break the alarm circuit are installed on a common zone with shorting type device, the circuit breaking devices shall be wired electrically downstream of the shorting type devices.
- B. All fire alarm system wiring shall be installed in an approved raceway.
- C. All fire alarm system wiring shall be multiconductor, UL listed FPL for limited energy (300 volt) and fire alarm applications, and NEC approved fire alarm cable. Wiring shall be installed in accordance with NEC, Article 760 of NFPA Standard 70 and manufacturer's recommendations. All wiring shall be copper and installed in conduit sized in accordance with the National Electrical Code.
- D. Fire alarm system wiring shall be color coded.
- E. All fire alarm system junction boxes including covers, shall be secured, painted red and marked in white lettering as specified in Section 26 05 53.
- F. Wire size shall be determined by calculated voltage drop and circuit loading. Minimum wire size shall be as follows:
  - 1. #18 AWG twisted and shielded for data and communications circuits.
  - 2. #18 AWG for non-data and communications initiating and low voltage auxiliary control circuits.
  - 3. #16 AWG twisted for alarm circuits.
  - 4. #14 AWG for all power circuits.

## PART 3 - EXECUTION

### 3.1 GENERAL:

- A. Inspection: Installer shall examine the areas and conditions under which the fire alarm system is to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

- B. NECA: All fire alarm installations shall be in accordance with NECA 305-2001, Standard for Fire Alarm System Job Practices.

**3.2 SYSTEM DESIGN:**

- A. General: The basic equipment and device locations have been shown on the contract drawings. Specific wiring between equipment/devices has not been shown. It is the contractors responsibility to submit for approval the COMPLETE ENGINEERED system configuration and layout showing all devices, wiring, conduit, and locations along with other required information as specified herein.

**3.3 PROGRAMMING:**

- A. General: The fire alarm system installer shall provide programming to interface new fire alarm devices as required.

**3.4 INSTALLATION:**

- A. General: Install system and materials in accordance with manufacturer's instructions, roughing-in drawings, and details on the Drawings. Install electrical work and use electrical products complying with the requirements of the applicable Division 26 sections of these Specifications. Mount manual stations and alarm devices at heights specified in Section 26 05 00, "Basic Electrical Material and Method".
- B. Wiring: All wiring shall be in accordance with NFPA 72, the National Electrical Code, Local Codes, and Article 760 of NFPA Standard 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.
1. Install fire alarm system line voltage and low-voltage wiring in a suitable raceway. Conceal fire alarm system conduit except in mechanical rooms and areas where other conduit and piping are exposed. Fasten flexible conductors, which bridge cabinets and doors, neatly along hinge side and protect against abrasion. Tie and support the conductors neatly.
  2. All wiring shall be run in a supervised fashion (i.e. no branch wiring or dog-legged wiring) per NFPA requirements such that any wiring disarrangement will initiate the appropriate trouble signals via the main control panel per NFPA and UL requirements. Intelligent SLC loops may be T-tapped/branch wired due to inherent dynamic supervision.
  3. Wiring splices shall be kept to a minimum with required splices to be made in designated terminal boxes or at field device junction boxes. Transposing or color code changes of wiring will not be permitted. End-of-line supervisory devices shall be installed with the last device on the respective circuit. Said device shall be appropriately marked designating it as the terminating device on the respective circuit.
  4. No AC wiring or any other wiring shall be run in the same conduit as fire alarm wiring.
  5. Number code and color code conductors appropriately and permanently for future identification and servicing of the system.
- C. Conduit/Raceway: All wire shall be installed in an approved conduit/raceway system. Maximum conduit "fill" shall not exceed 40% per NEC.
1. Conduit and raceway system shall be installed as specified other Sections of the Specifications.
  2. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings. Conduit and raceway system shall be installed as specified under the general electrical sections of the specifications and per NEC. Maximum conduit "fill" shall not exceed 40% per NEC.
- D. Labeling: All system controls, indicators and other devices shall be labeled with names, designations and operating instructions as applicable. Labels shall be either engraved nameplates

or covered printed labels and shall be approved by the Engineer. All water flow switches which are hidden shall have identification points. These identification points shall be red tags with white lettering indicating location of the water flow switch. Tag location will be visible from corridors.

- E. Checkout: Check wiring to ensure that wiring is in accordance with the system manufacturer's wiring diagrams and that the system is free of open circuits, short circuits, and grounds.
- F. Identification: Refer to Section 26 05 53 for additional requirements concerning painting, nameplates, and labeling.

### 3.5 COORDINATION:

- A. It shall be the responsibility of the installing contractor to coordinate all requirements surrounding installation of the fire alarm system with all trades. Adequate coordination shall be provided to ensure proper installation and interface to all peripheral items required to interact with the fire alarm to provide a complete and functional life safety system.
- B. The installing contractor shall be fully responsible for coordinating all system and device messages and system operation with the Owner's Representatives and Operating Personnel.

### 3.6 SYSTEM CHECKOUT AND TEST:

- A. All final control panel connections shall be made by a state licensed, factory-trained technical representative of the manufacturer and who shall supervise a System Checkout and Test to demonstrate and confirm to the Engineer, Owner's Representative and the fire department, that the fire alarm system is 100% operational upon completion of the installation, and that it complies with all local code requirements and these specifications. It is intended that the System Checkout and Test be followed by a continuing program of inspection testing and maintenance. The Contractor shall provide a proposal to the Owner for a Maintenance, Inspection and Quarterly Testing Contract in compliance with NFPA 72H, upon completion and system checkout.
- B. The System Checkout and Test shall be performed within 30 days after the fire alarm installation and all peripheral systems are completed. The System Checkout and Test shall be performed by a minimum of two licensed fire alarm system technicians, one of which is licensed by the State of Texas, and acceptable to the Engineer and the authority having jurisdiction. The test shall be performed in two parts and two-way radios for use by the test observers shall be provided. The first part shall be a full dry-run test with all subcontractors present, but without the Owner's Representative or fire department present. After the dry-run test is successfully completed, then the final test with the Owner's Representative and fire department present shall be performed.
- C. This Contractor shall coordinate the test schedule with all necessary parties and subcontractors required to be present for a complete and functional test.
- D. The System Checkout and Test which is a comprehensive 100% inspection and test of all fire alarm system equipment and shall include, but not be limited to the following:
  - 1. Fire Alarm Control Equipment:
    - a. A visual and functional test of all fire alarm control and auxiliary control equipment.
    - b. A visual inspection shall be conducted to establish that all electrical connections and equipment as required are properly installed and operating.
    - c. A remote functional fault simulation test shall be conducted on all relevant field wiring terminations to ensure that all wiring is properly supervised as required.
    - d. All indicators shall be tested to ensure proper function and operation.
    - e. All device messages shall be verified to be correct, as installed.
    - f. All system auxiliary functions including, but not limited to, CPU reporting, elevator recall, fire/ smoke door and shutter control, security interface, HVAC equipment control and





reporting. The report shall contain the testing information, stating the precise location and operational status of each and every peripheral device and shall include a Fire Alarm System Certification and Description Document per NFPA 72.

- c. The 100% System Checkout and Test shall be performed by factory-trained representatives, and one of the individuals shall possess a state license for fire alarm installation supervision.

**3.7 OPERATING AND MAINTENANCE DATA:**

- A. The system manufacturer shall submit fire alarm system Operating & Maintenance (O&M) Manuals with complete system documentation including test reports and record drawings.
- B. The manufacturer's authorized representative shall instruct the Owner's designated employees in the proper operation of the system and all required periodic maintenance. This instruction will include three copies of a written summary in booklet or binder form so employees can retain for future reference. Basic operating instructions for the system shall be framed and mounted at the main control unit.

**3.8 WARRANTY:**

- A. The fire alarm and security systems shall be warranted against defects in workmanship and materials, under normal use and service, for a period of one year from the date of acceptance by the Owner. Any equipment shown to be defective shall be repaired, replaced or adjusted free of charge.
- B. The warranty period shall begin after successful completion of the Owner's inspections and tests. In the event of any system malfunctions or nuisance alarms, the Contractor will take appropriate corrective action. This action may necessitate a repeat of the response test if the Owner so desires. Continued improper performance during warranty shall be cause to require the Contractor to remove the system.
- C. The warranty start date will not begin until after a period of 30 consecutive days of system operation without any nuisance alarms caused by malfunctioning of hardware or software.

**END OF SECTION**

E&C Engineers & Consultants Inc.  
TX Firm Registration No. F-003068

This Page is Intentionally Blank